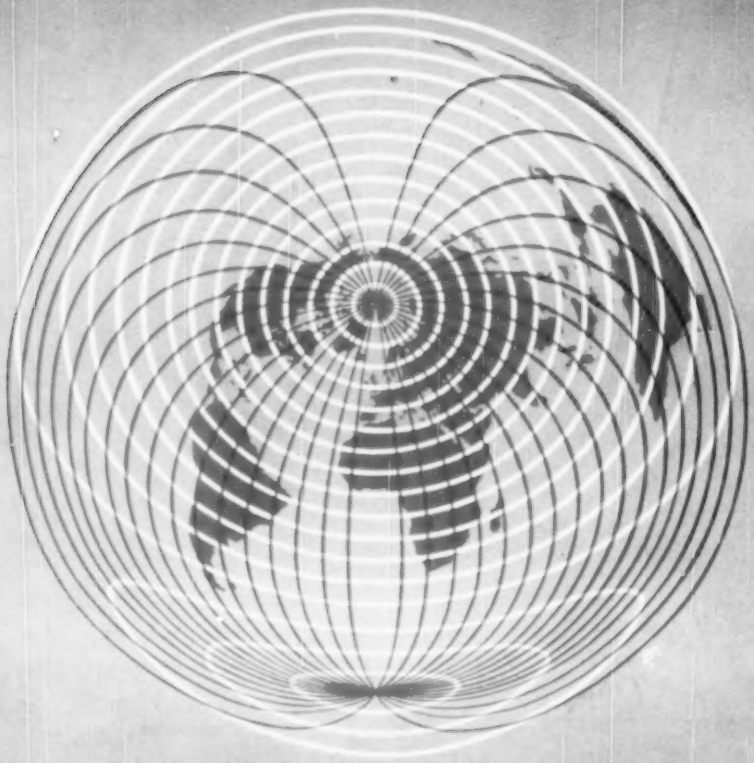
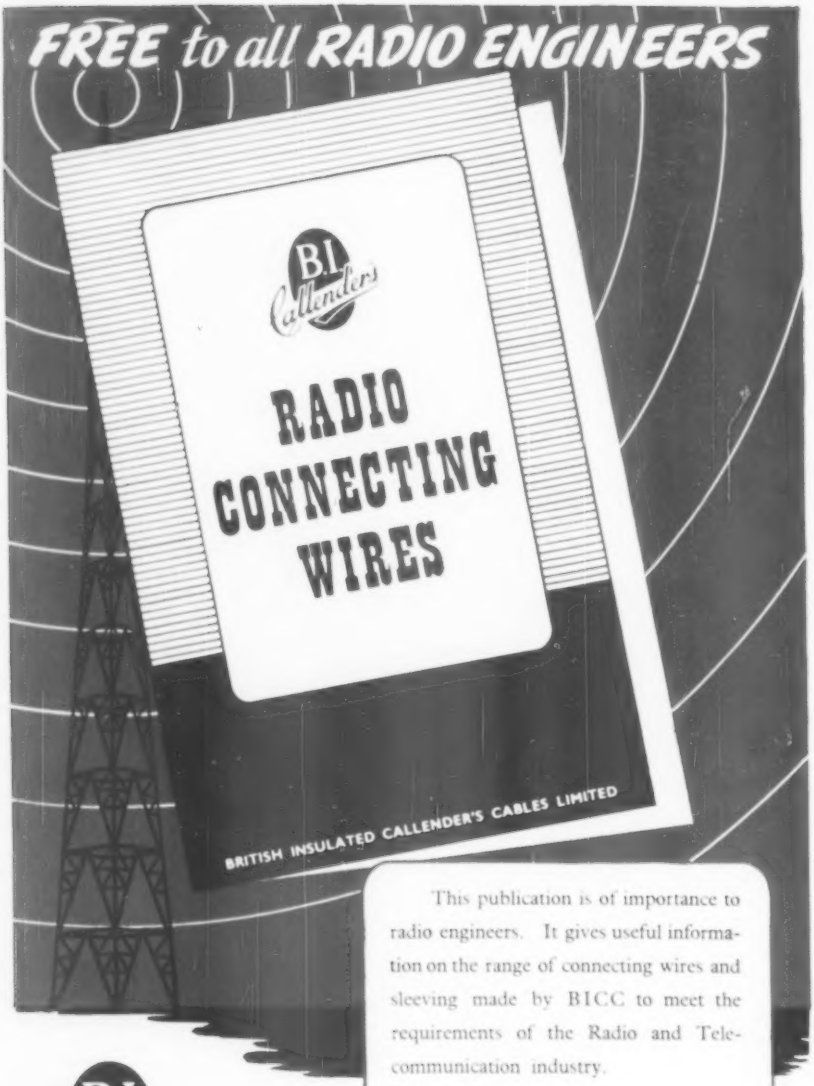
Wireless World

RADIO AND ELECTRONICS



Vol LVI No 3 Two Shillings March 1950

FREE to all RADIO ENGINEERS



This publication is of importance to radio engineers. It gives useful information on the range of connecting wires and sleeving made by BICC to meet the requirements of the Radio and Telecommunication industry.

Write to-day for Publication 247T

B.I. Callender's

BRITISH INSULATED CALLENDER'S CABLES LIMITED
NORFOLK HOUSE, NORFOLK STREET, LONDON, W.C.2

Important ANNOUNCEMENT to users of the AVO VALVE TESTER

In response to popular request, we are pleased to announce the availability of the following accessories, which provide an inexpensive means of bringing the "Avo" Valve Tester completely up-to-date. Possession of these accessories will, furthermore, render it a simple matter to maintain the "Avo" Valve Tester in a condition capable of testing any new types of valves that may be produced in the future.

ACCESSORIES for the 'AVO' VALVE TESTER

FILAMENT VOLTAGE EXTENSION UNIT

For providing filament voltages of 1.4 to 117 volts for testing valves recently introduced into general use and which are not covered by the original "Avo" Valve Tester.

This unit is plugged in between the Meter panel and the S.S. panel, where it may be left permanently in position regardless of whether the original or the additional heater voltages are being used.

VALVE BASE ADAPTORS

These Adaptors have been specially designed for plugging into the international octal socket of any "Avo" Valve Tester Panel which is fitted with a rotary selector switch. The following types, covering recently introduced valve bases not provided for on the existing Valve Panel, are now available :—

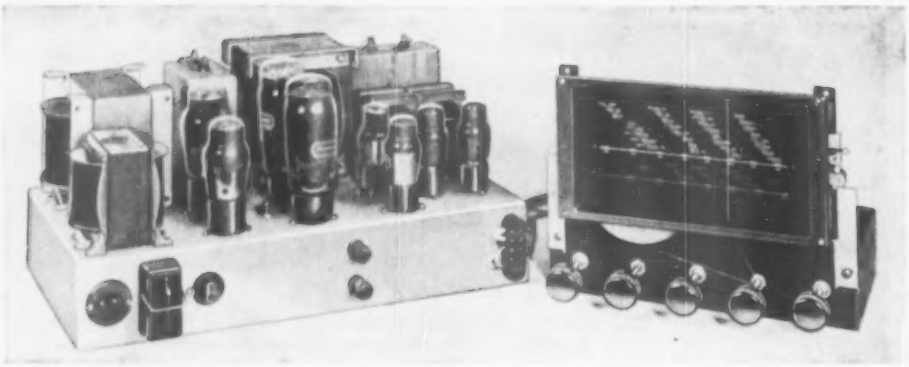
Type No. 1 ..... B7G and B8A.
Type No. 2 ..... B9G (EF50, etc.).
Type No. 3 ..... B8B (American Loctal).
Type No. 4 ..... Hivac Midget 4 and 5-pin and Midget Diode.
Type No. 5 ..... Blank.

Other types will be made available as required, and Adaptors can also be supplied for any special valve base.

Sole Proprietors and Manufacturers :

The AUTOMATIC COIL WINDER & ELECTRICAL EQUIPMENT CO. LTD.
WINDER HOUSE • DOUGLAS STREET • LONDON • S.W.1 *Telephone: VICTORIA 3404/9*

V.T.E.1.



GOODSELL

15-WATT HI-FIDELITY AMPLIFIERS ARE UNSURPASSED IN PERFORMANCE

AS DESCRIBED BY T. D. N. WILLIAMSON IN "*Wireless World*" AUG. 1949.

The fidelity of reproduction given by the Williamson Amplifier is now an accepted standard throughout the world. This high standard is made possible by the following important features.

- Specially designed output transformer.
- Low phase shift.
- Heavy feedback, which includes the output transformer and all the valves.

These features make possible :

- Low linear distortion, with less than 0.1 per cent. harmonic content.
- Low intermodulation distortion.

Our amplifiers are built to strict specification and incorporate only the finest components. After assembly and adjustment by experts they are severely tested to ensure the highest possible standard of performance.

PRICES:

Amplifiers ..... from **£19 19 0** } No tax
Pre-Amplifiers ..... from **£8 0 0** }
Tuners ..... from **£10 10 0** Plus tax

and NOW

A small amplifier of 6-7 watts, push-pull output, with 20 db feedback. Linear response from 30-15,000 cycles, low distortion and complete stability, designed to set a new standard of listening for the domestic user, having one of the excellent 10in. loudspeakers which are now available.

Valves : EF37, 6SN7, 6L6g (2), 5U4g, price **£14 14**

With built-in two-stage tone-control unit **£18 18**

Full details in illustrated leaflet.

Send for free illustrated brochure.

Manufactured by **GOODSELL LTD, 40 GARDNER ST., BRIGHTON, SUSSEX** *Telephone: 6735*

Easy Terms from LONDON RADIO SUPPLY CO., Balcombe, Sussex.

SEI

serves

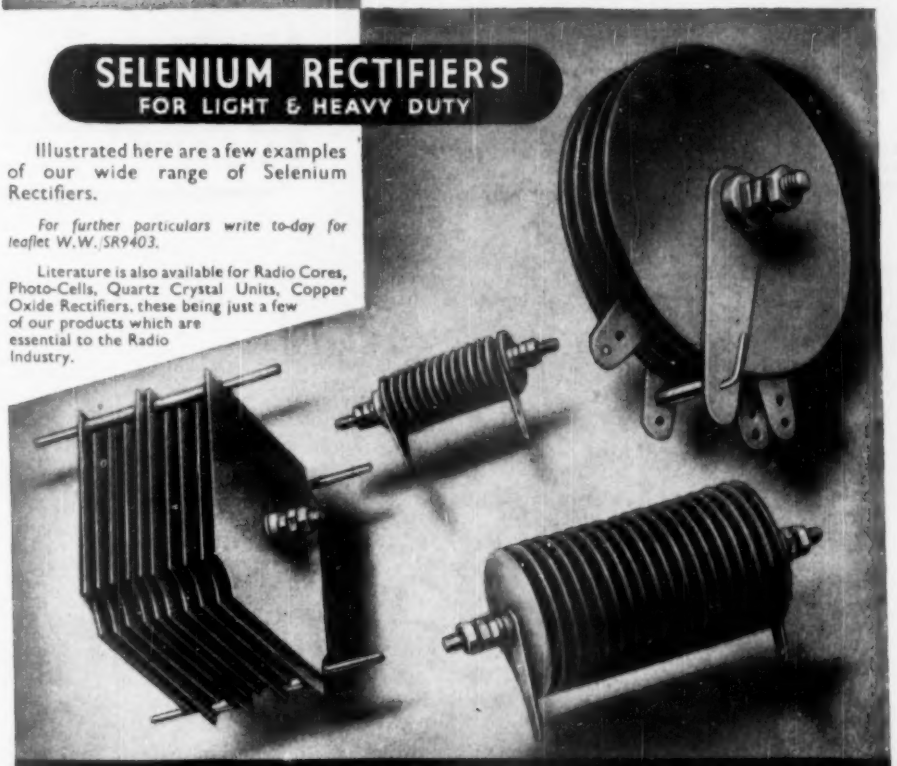
THE RADIO AND TELEVISION INDUSTRY

SELENIUM RECTIFIERS
FOR LIGHT & HEAVY DUTY

Illustrated here are a few examples of our wide range of Selenium Rectifiers.

For further particulars write to-day for leaflet W.W. SR9403.

Literature is also available for Radio Cores, Photo-Cells, Quartz Crystal Units, Copper Oxide Rectifiers, these being just a few of our products which are essential to the Radio Industry.



SALFORD ELECTRICAL INSTRUMENTS LTD.
PEEL WORKS · SILK STREET · SALFORD 3 · LANCS · ENGLAND
A subsidiary of THE GENERAL ELECTRIC CO. LTD. OF ENGLAND

WINDSOR AUDIO OSCILLATOR

ALL WINDSOR & TAYLOR TEST EQUIPMENT IS AVAILABLE ON H.P. SEND FOR DETAILS AND CATALOGUES

TAYLOR ELECTRICAL INSTRUMENTS LTD
419-424 MONTROSE AVENUE, SLOUGH, BUCKS, ENGLAND
Telephone SLOUGH 21381 (4 lines) • *Grams & Cables TAYLINS, SLOUGH*

MODEL 190A

SPECIFICATION

CIRCUIT
A conventional R.C. oscillator circuit is used employing two triodes with negative feedback.

FREQUENCY RANGES
20-20,000 c.p.s. in 3 ranges.

POWER OUTPUT
Maximum output is 500 milliwatts matched to either 600 ohms or 5,000 ohms.

POWER SUPPLY
100-125 and 200-250V. 40/100 c/s.

LIST PRICE £22.10.0
EARLY DELIVERY

other products include:
Multirange A.C. D.C. Test Meters • Signal Generators • Valve Testers • A.C. Bridges • Circuit Analysers • Cathode Ray Oscillographs • High and Low Range Ohmmeters • Output Meters • Insulation Testers • Moving Coil Instruments

NEW

SERIES 800 ELLIPTICAL

(Type 874)

CAN 4 8? Of course it can't. And a 4" speaker can no more equal the performance of an 8" than a quart can come out of a pint pot.

BUT that is no reason why a 4" speaker cannot be a really good 4" speaker. Precision in machining, exactness of assembly and, of course, CO-AXIAL ALIGNMENT of all component parts is just as important as in any other of our speakers.

Dimensions and Data
Horizontal 7.1" (18 cm.)
Vertical 4.1" (10.3 cm.)
Axial 2.4" (6 cm.)
Flux Density 8,000 or 9,000 Gauss

We are really pleased with our 4" × 7" Elliptical. So will you be when you hear it.

REPRODUCERS AND AMPLIFIERS LIMITED
FREDERICK STREET WOLVERHAMPTON ENGLAND
Telephone: Wolverhampton 22241
Telegrams: "Audio, Wolverhampton."

R&A

We recommend this tube

because

It has a specially flat face.

It gives a bright, pleasantly coloured image.

Ferranti reliability ensures long life.

It gives freedom from ion burns.

The price is reasonable.

FERRANTI

FERRANTI CATHODE RAY TUBES

There's a keen demand for this Ferranti T12/46 12" Television Tube, so place your order NOW!

FERRANTI LTD MOSTON MANCHESTER 10; & 36 KINGSWAY LONDON WC2

The Quality of
old Craftsmanship
in Modern form

Furzehill

INSTRUMENTS

d.c. coupled cathode ray oscilloscopes
oscilloscope cameras
valve voltmeters
a.f. attenuators
beat frequency oscillators
stabilised power supply units
high dissipation resistance boxes

Please write for our catalogue

FURZEHILL LABORATORIES LIMITED
BOREHAM WOOD · HERTS · Tel: ELStree 1137

BUILD YOUR OWN E.H.T. UNIT

A range of units is now available for the construction of simple, efficient and safe E.H.T. units. The unit illustrated is a pulse-driven multiplier for 6kV output. No alterations are required to the line scanning transformer. The unit is simply added to an existing circuit. Other units are available providing 1.7-, 3- and 5kV, from the normal 350-0-350 volt H.T. transformer.

WESTINGHOUSE
WESTALITE

36 E.H.T. RECTIFIERS

Send 3d. for full details and circuits to

Dept. WW.3

Westinghouse Brake & Signal Co. Ltd.,
82 York Way, King's Cross, London, N.1

Television

AERIAL FEEDERS

Scientifically designed cables for efficient service in all areas

Retain this page as your guide to improved picture quality

TELCON YOUR GUARANTEE

CHARACTERISTICS & NOMINAL DIMENSIONS

CHARACTERISTIC IMPEDANCE ohms	50 Ω Coaxial		75 Ω Coaxial			80 Ω Twin		
SERVICE AREA	Local	Fringe	Local	Local	Fringe	Local	Local	Fringe
CODE NUMBER	K16M	AS93M	PT1M	K19M	AS60M	K20	K12SM	BA24PSM
DESCRIPTION	Solid	Air Spaced	Solid	Solid	Air Spaced	Unscreened	Screened	Screened
CAPACITY μμ F/Foot	29	22.5	21.5	21.5	17	19.5	19	22
Attenuation db 100ft. 1 Mc/s ..	0.7	0.24	0.4	0.65	0.2	0.3	1.2	0.5
45 " ..	4.8	1.7	2.6	3.7	1.5	2.1	5.9	2.5
100 " ..	7.1	2.6	4.2	5.7	2.4	3.2	7.5	3.6
Diameter in inches :—								
Over Copper Conductor ..	7/0.0076	7/0.022	0.022	7/0.0076	0.048	0.036	0.029	0.048
" TELCOTHENE ..	0.085	0.180	0.128	0.128	0.200	—	0.070	0.088
" Twin Cores	—	—	—	—	—	0.19 x 0.1	0.140	0.200
" Wire Braid	0.109	0.210	0.152	0.152	0.230	—	0.180	0.237
" TELCOVIN Sheath ..	0.159	0.275	0.202	0.202	0.300	—	0.232	0.297

Dielectric is TELCOTHENE* and Sheath is TELCOVIN (P.V.C.)

*Polythene processed by Telcon to provide specific characteristics.

Prices and samples may be had on application to the sole manufacturers.

THE TELEGRAPH CONSTRUCTION & MAINTENANCE CO. LTD

Founded 1864

Head Office: 22 OLD BROAD STREET, LONDON, E.C.2 Telephone: LONdon Wall 3141

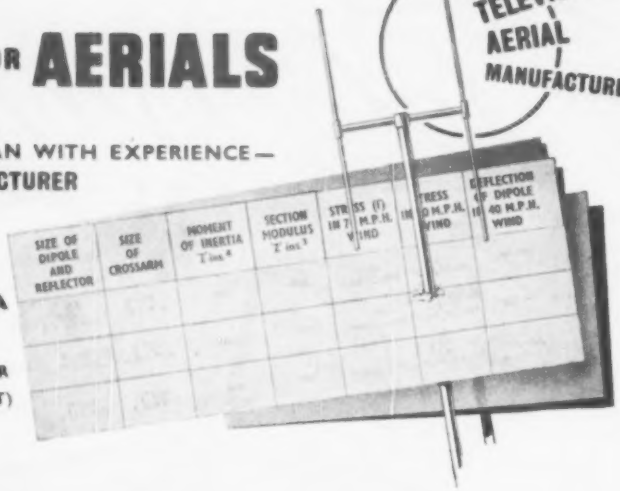
Enquiries to: TELCON WORKS, GREENWICH, S.E.10 Telephone: GREenwich 3291

SPECIAL ALUMINIUM

TUBING FOR AERIALS

TO TELEVISION AERIAL MANUFACTURERS

BUY FROM THE MAN WITH EXPERIENCE—
THE TUBE MANUFACTURER



SUPPLY FULL
TECHNICAL DATA
WITH THEIR SPECIAL ALUMINIUM TUBING FOR AERIALS (NO EXTRA COST)

Southern Forge LTD

IN ASSOCIATION WITH ALUMIN LIMITED

MEADFIELD ROAD · LANGLEY · BUCKS · Tel: LANGLEY 301

INTRODUCING THE R22/12, 20-WATT, 12" P.M. LOUDSPEAKER

MORE POWER—STILL GREATER EFFICIENCY—
the ultimate development of the famous T2

Available with two types of Cones:—

CONE TYPE "1205"
Fundamental Resonance 75 c.p.s.
[Designed for PUBLIC ADDRESS]

CONE TYPE "1206"
Fundamental Resonance 55 c.p.s.
[Designed for BASS REPRODUCTION]

Write for descriptive leaflet D30.

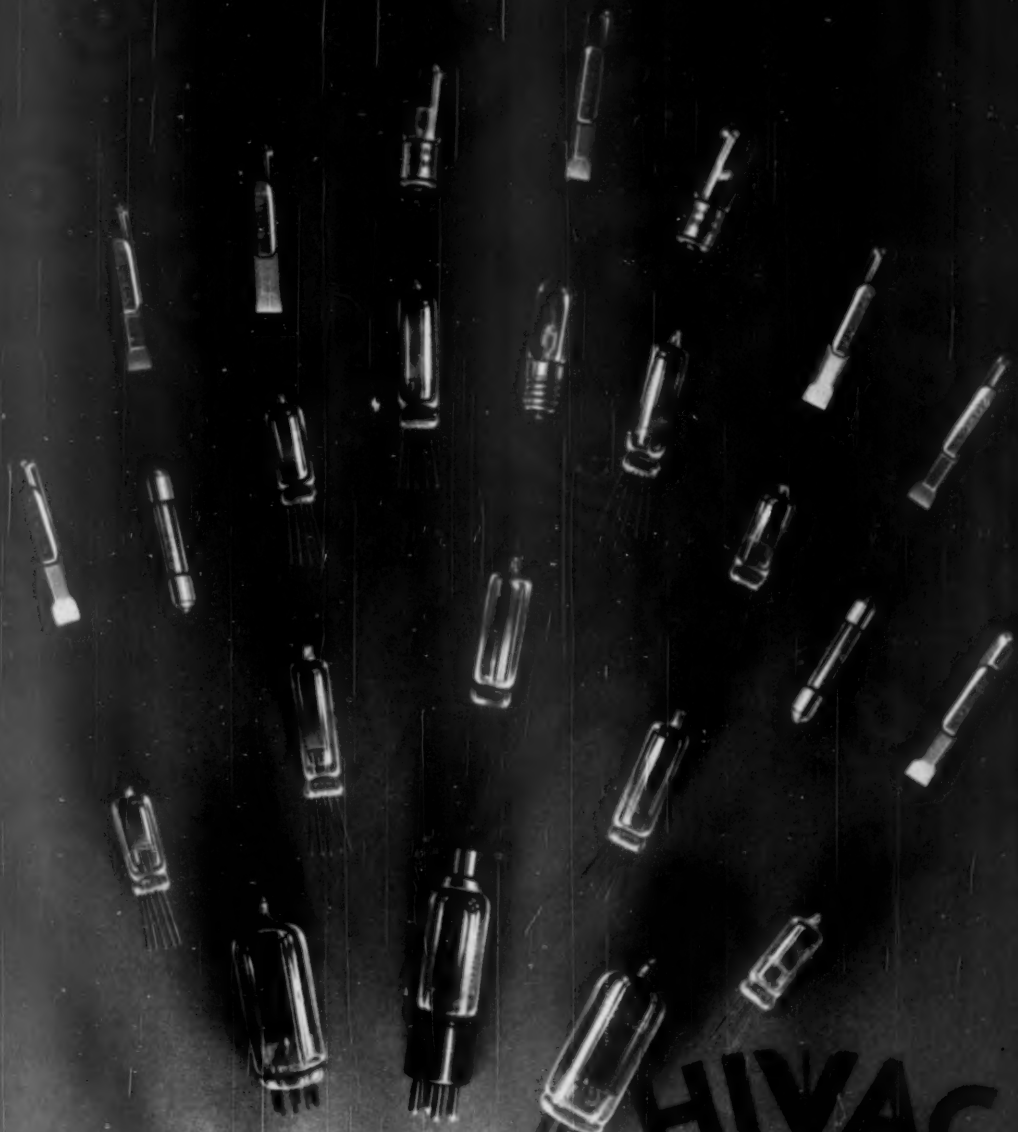
A TRADITION OF EXCELLENCE

GOODMANS

R22 20-WATT 12 P.M. 17,500 GAUSS *Loudspeaker*

FULLY DUSTPROOF

GOODMANS INDUSTRIES LTD. Lancelot Rd., Wembley, Middx.
Telephone: WEMbley 1200 (8 lines) Telegrams: Goodaxiom, Wembley



HIVAC Miniature and Sub-miniature Valves—Electrometer and Cold Cathode Valves—Telephone Switchboard Lamps—are used by the World's leading manufacturers.

HIVAC
THE SCIENTIFIC VALVE

HIVAC LIMITED, GREENHILL CRESCENT, HARROW-ON-THE-HILL, MIDDLESEX, ENG
Telephone: HARrow 2655. Cables: Hivac, Harrow

Simon
RECORDING EQUIPMENT

DESIGNED BY SPECIALISTS FOR THE SPECIALIST

EM49A MIXER UNIT

A very efficient four channel electronic mixer employing the latest type low noise valves. Three microphone channels and one pick-up or radio channel, each with independent fader, are provided.

Inputs 1.2.3 :	20Ω at 70 microvolts
Input 4 :	50 kΩ at 300 millivolts.
Output :	1 volt. Imp : 5.5 kΩ.
Noise Level :	—60 db approx. at full output.
Response :	± 1 db 50 c/s to 20 k/cs.
Dimensions :	5in. x 14in. x 9½in.
Weight :	10 lbs.

VC12 CONVERTER

A compact vibratory converter for battery operation of recording equipment and all applications where frequency stability is required. Housed in steel case finished in blue stove enamel and fitted with chrome carrying handles. Equipped with voltmeter and output frequency control.

Input :	12 volts D.C.
Output :	230 volts, 50 cycles.
Rating :	150 watts.
Dimensions :	13in. x 6½in. x 8in.
Weight :	26 lbs.

DR49A DISK RECORDER

A professional disk recorder of advanced design for use with existing amplifying equipment or as a companion unit to our self-contained recorder CDR49A.

The carrying case is finished in dark blue leatherette and equipped with locks, carrying handles and detachable lid.

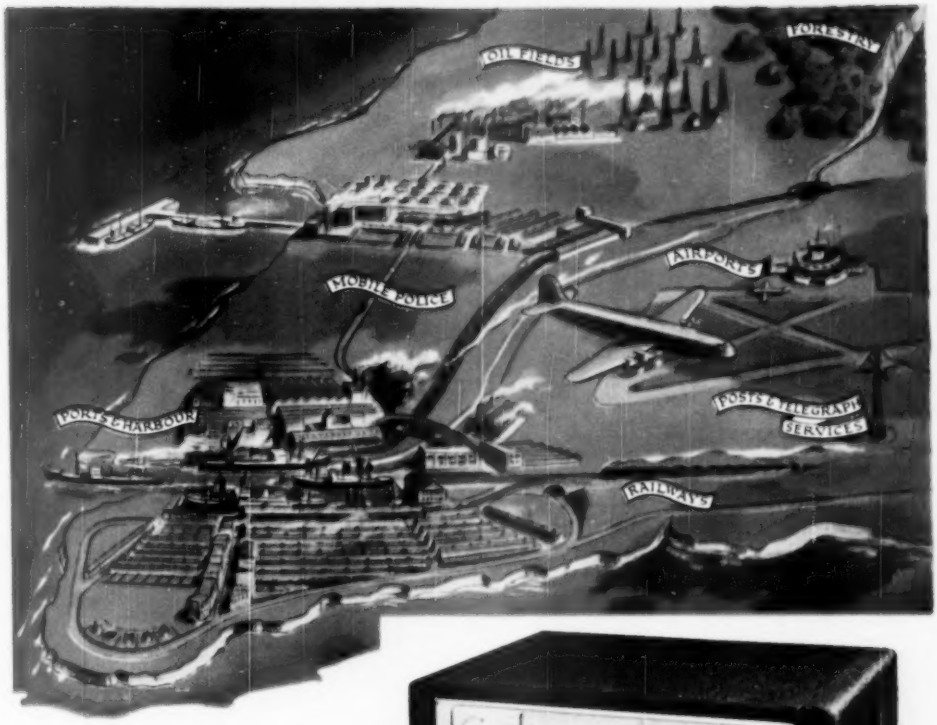
Capacity and Speed :	5in. to 13in. disks at 78 r.p.m.
Drive :	1/50 h.p. fully synchroncus motor.
Cutting Head :	Improved design 15Ω magnetic head. Response level ± 2 db up to 12 k/cs. Requires 4 volts input (1.05 watts) for full modulation at 1 k/c.
Other Features :	Variable groove pitch (80/120 g.p.i.), depth of cut and stylus angle. Inside or outside start. Scrolling control with automatic closure of final groove.
Dimensions :	20in. x 14in. x 13½in.
Weight :	40 lbs.

SIMON SOUND SERVICE

Recorder House, 48/50, George Street, Portman Square, London, W.1, England

Telephone: **Welbeck 2371 (4 lines)** *Telegrams*: **Simsale, Wesdo, London** *Cables*: **Simsale, London**

G.E.C. RADIO COMMUNICATION EQUIPMENT FOR USE IN ALL PARTS OF THE WORLD

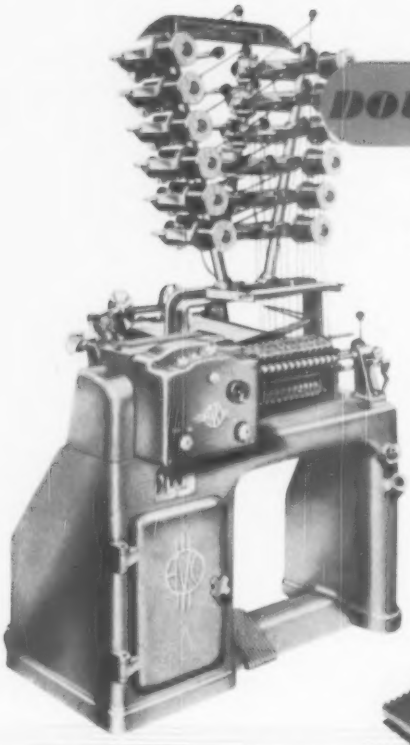


The G.E.C. with its unique research organization has always been in the forefront of radio development, and its enormous manufacturing resources have enabled these developments to be put into production. Where line telephony and telegraphy communications come up against geographical barriers, and where speed, security and mobility are important, the Company's specialists are freely available for consultation.

FOR EXAMPLE: THE GENERAL PURPOSE COMMUNICATION RECEIVER BRT.400 is built to meet the most exacting requirements of commercial service in all parts of the world, for high grade telegraphy service and quality reception for re-broadcast.

G.E.C. RADIO COMMUNICATION EQUIPMENT

THE GENERAL ELECTRIC COMPANY LIMITED OF ENGLAND · MAGNET HOUSE, KINGSWAY, LONDON

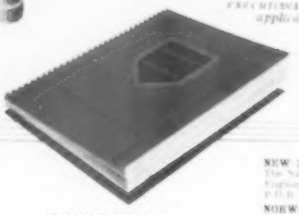


DOUGLAS AND MACADIE

Automatic COIL WINDERS

The accompanying illustration of the newest "Douglas" Fully Automatic Multi-Winder is a typical example of the superiority of design and workmanship which are the outcome of our many years of specialised experience in the manufacture of Coil Winding Machines. There is a "Douglas" or "Macadie" Machine for every coil winding need. For speed, efficiency and economy, there are no better machines.

Twenty-two different Coil Winders and Taping Machines are illustrated in our latest Catalogue, a copy of which will be sent to interested executives on application.



OVERSEAS AGENTS:—

AUSTRALIA
Messrs. AU-Ecc. Pty. Ltd.,
Herbert Street, St. Leonards,
New South Wales.

BRAZIL
Messrs. Companhia Material Eletrico,
Rua da Alfandega 71 A,
Rio de Janeiro.

BURMA
Messrs. E.E.R.T. Co.,
61, Fraser Road,
Cantonment, P.O.
Rangoon.

CANADA
Messrs. [illegible] Ltd.,
[illegible] Cambridge Street,
Ottawa, Ontario.

CHILE
Messrs. Hector & Co. Ltd.,
Casilla 1051 Post Box,
Santiago.

CHINA
Messrs. Ewin Hodgson & Co. Ltd.
Nanking 2321 Bank Buildings,
Queen Road Central,
P.O.B. 33, Hong Kong
and
40, Museum Road,
P.O.B. 168, Shanghai.

CYPRUS
Dem. Chr. Kadellides,
P.O. Box No. 1, Larnaca.

CZECHOSLOVAKIA
Messrs. Elektronia Co. Ltd.,
Prokopska 42, Prague XVI.

DENMARK
Messrs. A/S Dell,
Thorsgade 53, Copenhagen.

EGYPT, SYRIA & PALESTINE
Messrs. T. T. Gastagli & Co. Ltd.,
15, Sharia Sherif, Hamza, Cairo.

EIRE
Messrs. Kelly & Shiel Ltd.,
Corbet Works,
Distillery Road, Dublin.

FINLAND
Messrs. O. Y. Danfer, A.B.,
Kansakoulukatu 5, Helsinki.

FRANCE
M. Lionel Meyer,
Les Essarts Fontenay,
aux Roses (Seine),
Rue Gerbert (X. Ier).

GREECE
Messrs. A. Lycos & Co.,
Ag. Constantinou 4, Athens.

HOLLAND & BELGIUM
Messrs. Knecht,
Boomsingel 39,
Midden, Holland.

ICELAND
Messrs. Gunnar Gislason,
P.O.B. 159, Reykjavik.

INDIA
Messrs. Eastern Electric & Engineering Co.,
Cor. Mahatma Gandhi Road, Bombay.

IRAN
Mr. G. Hekmat Afshar,
Daneshgah Dehati,
Shah Reza Avenue, Teheran.

IRAQ
Messrs. Ali Khalid,
Rashid Street, 144/1, Baghdad.

KENYA, UGANDA, TANGANYIKA & ZANZIBAR
Messrs. Radio & Electric Services,
P.O.B. 78, Mombasa.

MALAYA
Messrs. Kac Hall Radio Co.,
14, Beach Street, Penang.

NEW ZEALAND
The National Electrical & Engineering Co., Ltd.,
P.O.B. 1705, Wellington.

NORWAY
Diplomingeniør Harald Lahn,
Kristiansdsgade 4, Oslo.

POLAND
Messrs. Economic Exports Ltd.,
3, Angel Court, Throgmorton St.,
London, E.C.2.

PORTUGAL
Messrs. Lescuyer, Lisbon, Ltd.,
Avenida 24 de Julho 3, Lisbon.

SIAM
Messrs. Allied National Corpn. Ltd.,
Arco House, Buckingham Gate,
London, S.W.1.

SOUTH AFRICA, NORTHERN & SOUTHERN RHODESIA
Messrs. Associated Engineers Co.,
Arco House, Cor. Miller & 9th Streets,
New Doornfontein, Johannesburg.

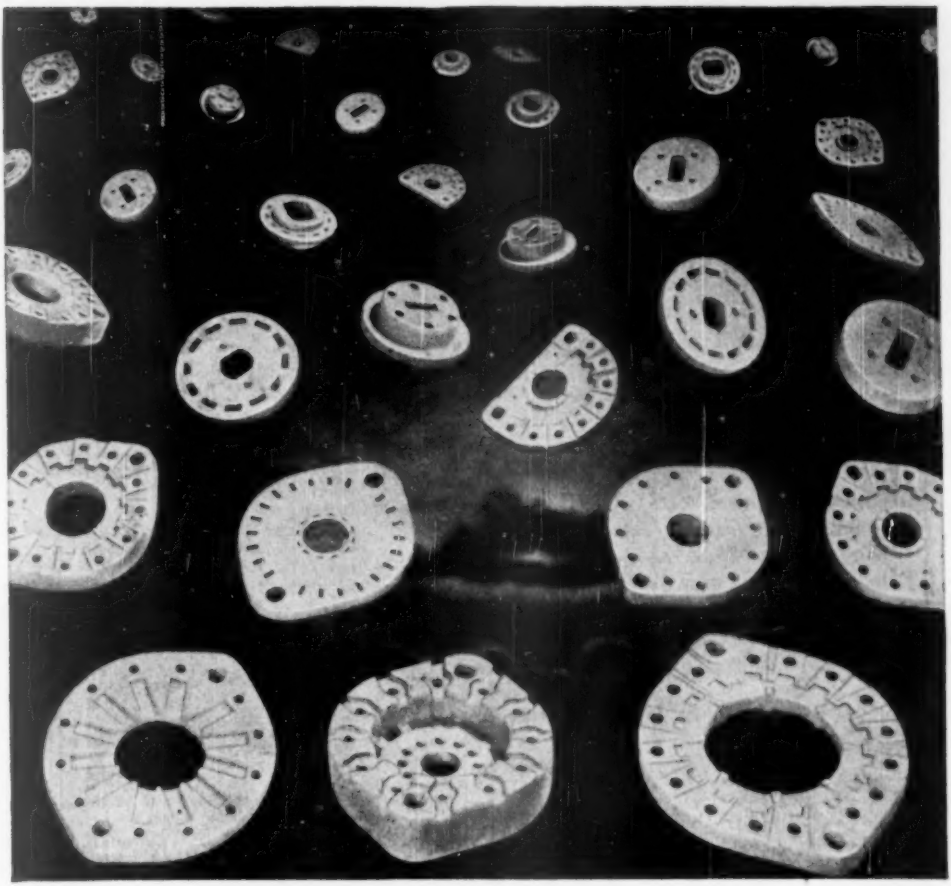
SPAIN
Messrs. Ecomet, S.A.
Calle de Lista 10, Madrid.

SWEDEN
Ingenjorsfirman Sigurd Holm,
R.S. Pettersgatan 17, Stockholm.

SWITZERLAND
Messrs. Technical Press, S.A.
3, Rue Gutenberg, Geneva.

TURKEY
Electroscopes Metrisit Vadi,
P.O.B. Istanbul 141, Istanbul.

The AUTOMATIC COIL WINDER & ELECTRICAL EQUIPMENT CO. LTD.



CERAMICS

FOR SWITCHES

and all radio components

FREQUENTITE-FARADEX-TEMPRADEX

STEATITE & PORCELAIN PRODUCTS LTD.

Stourport on Severn, Worcester Telephone: Stourport 111 Telegrams: Steatain, Stourport

S.P. 54

The MAGNAVISTA

TELEVISION LENS

LIKE THE FISHERMAN'S STORY

Magnavista Television Lenses greatly exaggerate but unlike his, the picture they give is true, undistorted and brilliant—but enough of fishy stories.

Magnavista Television Lenses give maximum magnification, angle of view, and are guaranteed against discolouration.

Join the great army of Magnavista viewers who KNOW that Magnavista magnification is Television perfection.

PRICES

Type	Tube	£	s.	d.
A.7	6"	3	3	0
A.1, A.2, A.4, A.5, A.8, A.9, A.9a, A.10, A.11, A.12	9"	4	14	6
B.1, B.3, B.4, C.1	10" & 12"	5	5	0
D.1	15"	5	15	6
A.3	9"	6	16	6
B.2, C.2	10" & 12"	7	7	0
C.1x	9", 10" & 12"	7	7	0

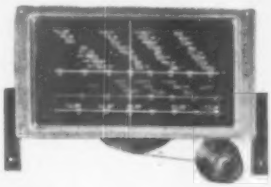
Straps are available for A.1, B.1, C.1 and D.1 models at **3s. 1d.** per pr.

METRO PEX LTD

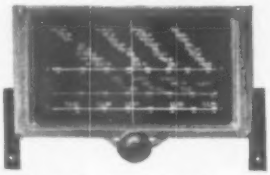
Head Office:
38, Gt. Portland St., London, W.1
('Phone: Museum 9024-5)

Midlands Depot:
Kings Heath Stn., Birmingham, 14
('Phone: Highbury 2765)

EXACT EFFORTLESS TUNING



The S.L.8 Spin wheel drive gives easy control through a ratio 24-1. Fitted with constant velocity coupling, it eliminates strain on the Condenser, providing mechanical and electrical isolation from vibration and noise.
Complete with 3-band glass scale 9" x 4¾". Printed short, medium and long wave bands with station names. Scale length 7". Supplied with florentine bronze escutcheon. **PRICE 25/-.**



S.L.5, similar but fitted with reverse vernier drive, gives ratios of 18-1 search, and 50-1 reverse vernier.
PRICE 24/-

PRECISION COMPONENTS BY

REGISTERED TRADE MARK

JACKSON

BROS. (LONDON) LIMITED

KINGSWAY — WADDON — SURREY

Tel: Croydon 2754. Grams: Welflica, Souphone, London

designed ....

with your specific needs in mind

MODEL 1035

The Cossor general purpose Oscillograph is designed and built by electronic engineers who are themselves familiar with the everyday problems which technicians have to face. The instrument consists of a Double Beam Tube operated at 2kV., a Time Base, Y Deflection Amplifiers and Internal Power Supplies. The 90mm. screen is flat, and traces are presented over the full area. Signals are normally fed through the Amplifiers, and the calibrated Y-Shift controls provide a measurement of the applied voltages. The Time Base operates repetitively, or by external trigger (for single stroke operation), or at trigger pulse repetition frequency for continuous scanning. A calibrated X-Shift Control is provided for the measurement of Time.

Model 1428 CAMERA

Specially developed for use with Cossor Oscillographs, it provides the simplest means of recording stationary or non-recurrent waveforms and slow transients by the moving film method on standard perforated 35 mm. film or paper. Of robust construction, it has provision for power drive by the Cossor Three-Speed Motor Attachment, Model 1429.

COSSOR

Double Beam OSCILLOGRAPH

Further details obtainable on application to :—

A. C. COSSOR LTD., INSTRUMENT DIVISION, HIGHBURY, LONDON, N.5

C8 19

TRIAL OF STRENGTH

To try the output strength of a small or mobile transmitter at any time and at a moment's notice, all you need is the Marconi TRANSMITTER OUTPUT METER, type TF 912. Covering the frequency range 80-160 Mc/s, it is battery-operated, self-contained and portable. The scale expansion of the meter is such that low power transmitters can be checked at an open part of the scale. The basic design feature is a bolometer bridge with moving coil indicator employing a 75 ohm resistively terminated input line of novel character. Further details are freely available.

Please ask for folder ***SUMMARY OF COMMUNICATIONS TEST GEAR***

TRANSMITTER OUTPUT METER
Type TF 912

Marconi Instruments Limited

ST. ALBANS, HERTFORDSHIRE · Telephone: St. Albans 6161/5

Northern Office: 30 Albion Street, Hull. **Western Office:** 76 Portview Road, Avonmouth. **Southern Office and Showrooms:** 109 Eaton Square, London, S.W.1. **Midland Office:** 19 The Parade, Leamington Spa

AERIALITE

makers of the world's best AERIALS & EQUIPMENT

Introduce their NEW—

AERIAL *Fitting* SERVICE

AERIALITE... the most advertised aerials made!

According to statistics supplied by "The Statistical Review," Aerialite Aerials are easily the most extensively advertised aerials made. Our present campaign includes advertising in the "Radio Times," "Daily Express," "Daily Mail," "News Chronicle," "News of the World," "The People," "Sunday Express," "London Evening News," "The Star," "London Evening Standard," and the leading Midlands papers. The public are asking for "AERIALITE," —The Best!

Are you missing sales through the inability to fit an aerial? If so, cash in now on the AERIALITE AERIAL FITTING SERVICE. This new service by the World's Largest Makers of Aerials applies to the wide range of AERIALITE TELEVISION and MASTATIC AERIALS.

We shall also be pleased to receive applications to join our organisation from dealers who have experience in aerial fitting.

EXAMPLE: Fitting of our new Popular D.P.O. MODEL 52. You can supply this low-priced Television Aerial complete and erected for **£8.0.0** only. D.P.O. MODEL 52. Complete with 10ft. steel mast and Chimney Lashing Brackets, etc., £4.10.0. Complete Erection Costs, £3.10.0—Total Cost £8.0.0. *Write today for full details.*

AERIALITE Ltd.
STALYBRIDGE, CHESHIRE

Make sure you can meet the demand!

YOU REALLY MUST HEAR

THE NEW CONCERT MASTER

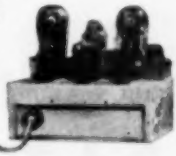
Here is a high-fidelity reproducing instrument with outstanding features and superb performance! It's the NEW CONCERT MASTER by CHARLES AMPLIFIERS — a magnificent achievement in technical and reproductive perfection!

Of its many advanced features, one is an EXCLUSIVE Detachable Control Head. This remote control unit can be detached, in a moment, from the main amplifiers chassis for convenience when mounting in a cabinet or can be used for armchair control. Alternatively the cable can be removed and the control head plugged into the main chassis to make a compact unit.

There are no valves in the control head to get damaged and no H.T. voltages. Triode valves are used throughout. Hum level is –90 db, two channel of bass boost are used to ensure unusually smooth balance and depth. The treble control has positions of lift and cut as well as a linear position.

Designed for high or low output pick-ups, the CONCERT MASTER has a pre-set matching control. Switch inputs include microphone, gram and radio. H.T. and L.T. is available for a tuning unit.

TWO YEAR GUARANTEE **£29 · 10 · 0**



DEFERRED TERMS on all models

Technical Specification:

Valves: 2 type P27/500, 3 x 6C5, 3 x 6SF5 (all Triodes!) 1 x 5U4.
Maximum: Output 10 watts.
Distortion: Below 0.5% at 10 watts.
Frequency Characteristic: Linear 30-20,000 c.p.s. taken overall including 6ft. cable.
Sensitivity: 30mV R.M.S.
Radio: .25v. R.M.S.
Input Impedance: 100,000 ohms.
Output Impedance: 3, 7, 15 ohms.
Hum Level and Background Noise: –80 db.
Supply Voltage: 200/250 A.C.

Write for fully illustrated Catalogue

TRICORNE SPEAKER CHAMBER

For optimum acoustic performance with any good 12-in. speaker. Labyrinth construction, walnut veneered and crossbraced.

Price **11 gns.**

plus 20/- deposit (returnable) for crate.

Charles

AMPLIFIERS (SALES) LTD

Phone: WEStern 3350

181, KENSINGTON HIGH STREET LONDON, W.8

Our equipment can also be seen at:

WEBB'S RADIO, Soho St., W.1. **SIGNAL SHOP**, 51, St. Mary Street, Bridgwater, Somerset. **ERNEST BUCHAN**, 28, Belmont Street, Aberdeen **FARMER & CO.**, 83, George Street, Luton

ALPHA BATTERIES

★ *First for quality*

★ *First for performance*

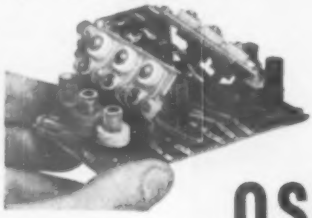
★ *First for reliability*

★ *First for long-life*

Alpha offer a range of batteries for radio and lighting second to none in high quality performance. Remember, too, that amongst the Alpha range of batteries for lighting, is the unique Leak-proof battery which will operate or store in any climate.

ALPHA ACCESSORIES LTD.
SALES OFFICE, GRAMOPHONE BUILDINGS
BLYTH ROAD, HAYES, MIDDLESEX
Telephone: Southall 2468, Ex. 793

All your switching Problems solved!



As specified for conversion of the T.R.1196

OSMOR 'Q' COILPACKS

Efficient Inexpensive

Just 5 connections (1-hole fixing) and all your coil and switching difficulties are over! The midget Osmor "Q" Coilpack saves you hours of wasted time and gives you a really first-class job at very little cost.
Pre-aligned with full instructions and complete circuit diagrams included.

★ **Portable battery model now available.**

Send stamp for FREE circuits and our new lists of coils, Coilpacks and matched radio components, also latest **Bargain Bulletin.**

OSMOR RADIO PRODUCTS LTD. (Dept. W.4.)
BRIDGE VIEW WORKS, BOROUGH HILL, CROYDON SURREY
Telephone: Croydon 1220.

FOR QUICK DELIVERY
AT
REASONABLE PRICES
OF
RADIO & ELECTRONIC PRODUCTS
(Wholesale Only)

Write or phone:—

S. Szymanski
(pronounced SHE-MAN-SKEE)

ELECTRONIC ENGINEER & STOCKIST
95 STRODES CRESCENT
STAINES, MIDDLESEX
Staines 3971

VALVES are our speciality—Probably the Largest Actual Stockist in England

EXPORT ENQUIRIES WELCOMED

Where excellent quality reproduction is essential . .

. . the Metrovick

AUDIO AMPLIFIER

is the instrument to use

This instrument is designed to give excellent quality reproduction with the added advantages of being a self-contained unit, portable and attractive in appearance. Thus it will prove ideal for Public Address work, educational authorities and similar organisations.

SPECIFICATION

Supply :	200/250V 50 c/s single-phase ; consumption approximately 170 VA for full output.
Input :	Gramophone 0·2V for full output. Microphone 0·02V for full output. The two circuits can be mixed as required.
Impedance :	7 ohms, 15 ohms and 45 ohms.
Output :	20 watts with negligible distortion.
Tone Control :	Continuously variable.
Response :	± 1 db from 30 to 15000 c/s at zero position of tone control.
Controls :	These are recessed to avoid damage and are illuminated when in operation.
Dimensions :	18½" × 8½" × 10¼".
Finish :	The instrument is housed in an attractive steel case, stove enamelled in cream or blue as desired. A leather carrying handle is fitted.

METROPOLITAN-VICKERS ELECTRICAL CO. LTD.

TRAFFORD PARK, MANCHESTER 17

R/E903

The EDDYSTONE '680' COMMUNICATIONS RECEIVER

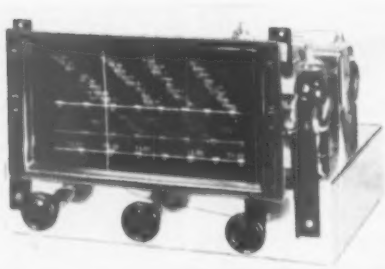
A high-grade instrument with wide frequency coverage for PROFESSIONAL COMMUNICATIONS REQUIREMENTS

The '680' is a fifteen valve superheterodyne receiver embodying advanced technique. Among its special features are included: continuous coverage from 30 Mc/s to 480 K/cs, two R.F. stages, two I.F. stages, crystal filter, B.F.O., push-pull output stage, variable selectivity, "S" meter, noise limiter, standby switch, stabilised H.T. voltage to oscillator, provision for relay operation of transmitter, high signal-to-noise ratio and sensitivity, highly attenuated image response, very effective A.G.C., provision for twin feeder and single aerial, modern miniature all-glass valves, mechanical bandspread logging device. Available for rack mounting.

The complete frequency range is covered by five switched coil assemblies with an overlap between each. The gear-driven, flywheel controlled mechanism is positive, free from backlash and very smooth in action. The mechanical bandspread device takes the form of an auxiliary dial and gives a scale length equal to ninety inches per range. The dial can be read to one degree. I.F. transformers are permeability tuned to 450 K/cs. Operates from A.C. mains 110 and 200/240 volts, 40/60 cycles. The front panel and tuner unit chassis are aluminium diecastings, and the remaining units of stout brass, heavily nickel-plated. Lift up lid. The cabinet and front panel are finished a fine ripple black, set off by plated handles. The finger plate is black and silver. 16½in. x 13¾in. x 8¾in. high. Weight 41 lbs.

LIST PRICE IN U.K. £89.5.0 (No Purchase Tax)

STRATTON & Co. Ltd., West Heath, Birmingham 31 Cables: STRATNOID BIRMINGHAM



YOUR CHASSIS, SIR!

YOU can build the handsome SUPERHET pictured above! It's so SIMPLE, failure is IMPOSSIBLE!

Yet the performance equals that of commercially built units at double the price. YOU can be proud of your achievement—since the cost is **well** within your pocket!

How is it done? Thousands of our delighted friends know that the secret lies in the use of the pre-aligned **MODEL 30 TUNING UNIT** comprising the famous 3 waveband model 30 superhet. Coil pack, pair of "MM" I.F. Transformers, dial (with new station names) and 2 gang Condenser—the WHOLE ALIGNED AND SEALED AS A UNIT! Price **54/9** (inc.) or **76/6** with J.B. spin-wheel Tuner. We supply **completely** punched chassis 12in. x 9in. x 2½in. at **10/6** ea., AND "Easy-as-A.B.C." construction sheets at **3/6** per set AND all Components for 30 Feeder Unit, 40 Feeder Unit (with R.F. stage), 5v. A.C., 5v. A.C./D.C., 6v. A.C. and 10 watt quality Amplifier. For further details, and a host of circuits, etc., send 1/- NOW for "The Home Constructor's Handbook" and Catalogue. All standard Radio and Television lines available, of course, at the KEENEST prices!

RODING LABORATORIES
(Mail Order Dept.)
70, LORD AVENUE, ILFORD, ESSEX
Phone: WAN. 1484

"You're CERTAIN to get it at ARTHURS!"

★ **VALVES:** We have probably the largest stock of valves in the country. Send your enquiries.

AVO METERS IN STOCK

Avo Model 7	£19 10 0
Avo Model 7, high resistance	£19 10 0
Avo Model 40	£17 10 0
Valve Tester	£16 10 0
Test bridge	£11 0 0
Avo Minor, AC/DC model	£8 10 0
Electronic Test Meter	£35 0 0
Signal Generator	£25 0 0
Valve characteristic meter	£40 0 0

TAYLORS METERS. List on request.

DECCA PICK-UPS	£3 15 5
DECCA HEAD for Garrard	£2 19 2
Adaptors	3 8
COSSOR DOUBLE BEAM OSCILLOSCOPE	£85 10 0

"Viewmaster" Television Kits in stock for Birmingham and London area. Please state which required.

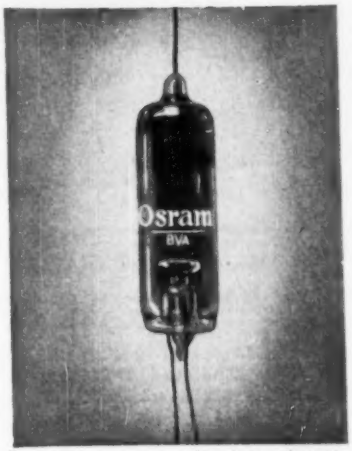
LATEST VALVE MANUALS
Mazda - 1/- ea.
Brimar - 2/6 ea.
Brimar Teletube & Radio - 4/-
Post 4d. each extra

LONDON'S OLDEST LEADING RADIO DEALERS

Arthurs EST. 1919
PROPS: ARTHUR GRAY, LTD. Terms C.O.D. or cash with order
Our Only Address: **Gray House, 150/152 Charing Cross Rd. London, W.C.2** TEMple Bar 5833/4 and 4765

ELECTRICAL, TELEVISION & RADIO ENGINEERS.

NEW high efficiency.



Actual size illustration

E.H.T. rectifier for Television Tubes

Osram

U37

MINIATURE BULB

The Osram Type U.37, because of its low heater rating, greatly improves circuit efficiency. This miniature directly-heated half-wave rectifier has been primarily designed to provide E.H.T. for cathode ray tubes from an R.F. source or by rectification of the fly-back voltage. It is a soldered-in type valve, 48 m.m. overall, excluding connections.

RATINGS

Filament Voltage	1.4 volts
Filament Current	0.14 amp
Peak Inverse Voltage	15 max. kV ★
D.C. Output Current	2 max. mA
Peak Anode Current	12 max. mA
Surge Anode Current	40 max. mA

★ For circuits where anode and filament voltages rise at approximately the same rate, e.g., as in fly-back and R.F. oscillator circuits. Where used on power input circuits with full A.C. anode voltage applied on switching, the maximum P.I.V. is 10 kV.

Osram

VALVES

THE POWER IN THE PACKAGE

THE GENERAL ELECTRIC CO. LTD. MAGNET HOUSE KINGSWAY, W.C.2

The best

HIGH & LOW

Exide AND Drydex

LOW TENSION ACCUMULATORS HIGH TENSION BATTERIES

for better battery radio reception

ISSUED BY CHLORIDE BATTERIES LIMITED

THE SOUND MAGNET

MAGNETIC RECORDERS MODEL X.L.

Complete portable machines with 10 w. P.P. amplifiers, internal pilot speaker, three forward speeds give ½, ¼ and 1 hour, with twin tracks for doubling programme time. Model XL in production. £47/10/0 List.

Please write (do not telephone) for an illustrated brochure and full details of this wonder machine with notes upon the aspects of magnetic recorder applications. Send 2½d. stamp to Dept. SM.

GENERAL LAMINATION PRODUCTS LTD.

294 BROADWAY, BEXLEYHEATH, KENT.

ICS

HOME STUDY

backs radio experience with sound technical knowledge

MANY men who wished to link their radio experience with a sound technological background have received successful instruction by means of an ICS Course. Its value has been proved not only to amateurs but to men who already have a professional interest in radio and television engineering, including those taking qualifying examinations. It is invaluable, also, to students who wish to prepare themselves for a job in this field. Courses of instruction covering radio and, if necessary, television, include the following :

Complete Radio Engineering · Radio Service Engineers
Radio Service and Sales · Advanced Short-Wave Radio
Elementary Electronics, Radar and Radio
Television Technology

And the following Radio Examinations :

British Institution of Radio Engineers
P.M.G. Certificates for Wireless Operators
City and Guilds Telecommunications
Wireless Operators and Wireless Mechanics, R.A.F.

Write today for our FREE "**Radio**" booklet which fully describes the above ICS Courses and the facilities for the complete study of Radio and/or Television technology. The ICS Advisory Department will also give free and impartial advice on the need of and the means of instruction.

International

CORRESPONDENCE SCHOOLS

Dept. W.L.8. nternational Buildings, Kingsway, London, W.C.2

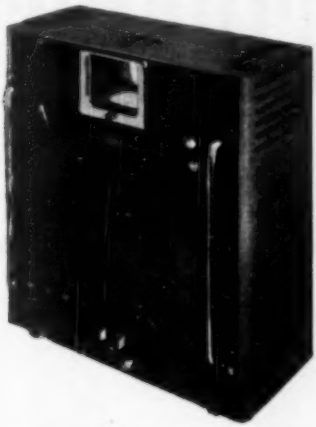
AIRMEC

OSCILLOSCOPES

It is the experienced engineer, familiar with the use of Oscilloscopes, who can best judge whether the Airmec Type 723 Oscilloscope meets the specification which we laid down when designing it. It was our aim that it should be a precision instrument of high quality, suitable for a wide range of applications, and so constructed as to be of maximum convenience in use. We believe we have achieved this object.

Our Pamphlet No. 19 is available on request and we shall be glad to send you this and other information about the instrument.

FOR A WIDE RANGE OF USES



- ★ Range from D.C. to 5 Mc/s.
- ★ Tube diameter 4" with flat screen.
- ★ Sensitivity 10 mV/cm.
- ★ Time base variable from 1 second to 1 micro-second repetitive or single stroke.
- ★ Three tube Voltages, 1kV, 2kV and 4 kV.

SIGNAL GENERATORS VALVE VOLTMETERS
RADIATION INSTRUMENTS
BRIDGE OSCILLATORS ELECTRONIC COUNTERS
INSULATION TESTERS COMMUNICATION TEST GEAR
INDUSTRIAL ELECTRONIC APPARATUS

The Quality of an AIRMEC product is outstanding

AIRMEC LABORATORIES LTD

HIGH WYCOMBE · BUCKINGHAMSHIRE · ENGLAND

TEL HIGH WYCOMBE 2060 *CABLES: COMMLABS HIGH WYCOMBE.*

DESIGNERS AND MANUFACTURERS OF SCIENTIFIC AND INDUSTRIAL ELECTRONIC EQUIPMENT

A.L. (A) 5

CERAMICS by U.I.C

UNITED INSULATOR COMPANY LTD. · TOLWORTH · SURBITON · SURREY · ENGLAND

Cables: Calanel, Surbiton. Telephone: Elmbridge 5241

M.R. SUPPLIES Ltd

offer the following **new and perfect** material for **immediate delivery**. We only handle goods which are sure to satisfy. Prices nett.

SANGAMO TIME SWITCHES (Synchronous 200/250 v. 50 c.). Standard 24-hour dial with optional one-day omitting device and manual on-off switch. Capacity 10 amps. Minimum period between operations 15 mins. Fitted pair of adjustable cleats for two operations per day. Compact housing, 4½ diam., 2½ depth. **£4 8 6** (despatch 1/6).

THERMOSTATIC SWITCHES. Adjustable range, 40/80 deg. F., differential 4 deg. F. Capacity 10 amps. Fitted manual on-off switch. Size 6½ × 2½ × 2½. The perfect temperature control for rooms, factories, laboratories greenhouses, etc., **39 6** (doc. 3/-).

REMOTE READING AIR (or immersion) THERMOMETERS. Scaled -32 deg. C. to + 55 deg. C. covering 0/131 deg. F.). Lectrosons. Approx. 19ft. tube to 12in. temperature rod. Conversion C. to F. table supplied. Ideal for measuring temperatures for processing, soil and propagation, photographic darkroom, etc., **10/-** (doc. 1/-).

ELECTRIC BLOWERS. Small efficient model, 3in. × 3½in. overall. 19/24 v. A.C./D.C., 5,000 r.p.m., quiet running. For electronic and lamp cooling, drying, etc., **15/-**. (We have suitable mains transformers at **22 6**.)

AIR COMPRESSORS. Up to 300 lbs. per sq. in. Overall length 6½in. Fitted splined driving shaft (power required about ¼ h.p.), **25/-**. Slightly soiled. (doc. 1/-).

SELENIUM RECTIFIERS. (Very useful range now in stock at attractive prices). All brand new. All full-wave. 24 v. 2·5 amp., **19 6**. 24 v. 6 amp., **37 6**. 12 v. 6 amp., **29 6**. Also heavy duty industrial type. Sealed cooled. D.C. delivery up to 30 v. 10 amps. A pair must be used for this delivery at full-wave rectification. Size 12½in. × 12½in. × 4½in., **79 6 each** (doc. 1/6 each). Also **H.T. SELENIUM RECTIFIERS.** D.C. delivery up to 300 v. 1·2 amp. A pair in bridge will provide A.C./D.C. mains operation at 1·2 amps., full-wave, **22 6** each, **39 6** pair. (These are slightly soiled but guaranteed electrically.) We have in stock suitable mains transformers for all rectifiers offered.

AMMETERS. First-grade m/coil with 3in. square flange. Deflection 0/30 amps., with external shunt. (Ideal for use with above industrial rectifiers. Clear even scale with 3-amp. divisions, **42 6**. Also 0/50 voltmeters in same style and make, **39 6**.

DECADE RESISTANCE BOXES, by best precision makers. Units 0/10. Tens 0/100, with additional 100-ohms (can be altered to multiplier). Fitted grade 1 m/coil galvano. Switching for Wheatstone Bridge and other tests, in fine portable case, 10in. × 7½in. × 6½in., **65/-** (doc. 2/-).

ROTARY CONVERTERS. New machines under half list price. Input 110 v. D.C., output 230 v. 50 c. 1 ph., 100 watts, **£5/17 6** (doc. 5/-). Also same machines mounted on 45 watt motor, 6/7v., **£9** (doc. 5/-).

P.A. PROJECTOR SPEAKERS. Exceptional opportunity for brand new G.E.C. 1506 15-watt Pressure Units, 15 ohms coil, with built-in line transformer in weather-proof sealing. £8 model for only **65/-** (doc. 1/6), or complete with 30in. all-metal Projector Horn, **£5 12 6**, carr. pd. U.K.

STAGE LIGHTING DIMMERS. Full-bright to blackout at 220/240 v. Sliding type, 100-watt, **32 6**. 200-watt, **37 6**. 300-watt, **50/-** (doc. 2/-). Screw motion type with hand-wheel, 1,000-watt, **60 3/-**, 2,500-watt, **69 5/-** (doc. 5/-). All fully enclosed.

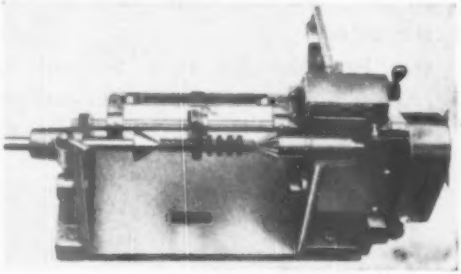
STEEL TRIPODS to suit all P.A. Speakers, extending up to 12ft. strong and rigid, **55/-** (no. England 3/-, Scotland and Ireland, 4/-).

ANODE CONVERTERS (Rotary Transformers). Repeat offer of this most useful rating. Input 12 v. D.C., output 240 v. D.C. at 125 m.a. Brand new in cartons ex original cases of eight, **25 6** each (doc. 1/6).

We ask you to note that all of the above material is in brand new condition and we always indicate if any item is soiled.

M. R. SUPPLIES Ltd., 68, New Oxford Street, London W.C.1

Telephone MUSeum 2958



MODEL WX

AUTOMATIC COIL WINDING MACHINES

AND HAND WINDING MACHINES

Wave winding machines for single or multiple coils 1/16" to ¾" wide for power drive.

SOLE AGENTS ABROAD

K. G. Khosla & Co., 22 School Lane, New Delhi, India.
Etablts Octave Houart, 14, Quai de l'Industrie, Sclessin-lez-Liege.
J. P. Fielding Co. (Canada), P.O. Box 35, Station 'H', Toronto, Canada.
Hoftye & Frogg, Oslo, Norway, Storgaten, 15.

ETA TOOL CO

(LEICESTER) LTD

29a, WELFORD ROAD, LEICESTER

'Phone—5186

TRIX

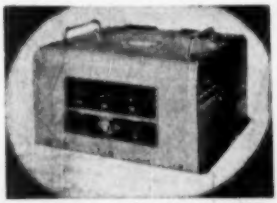
Quality

SOUND EQUIPMENT

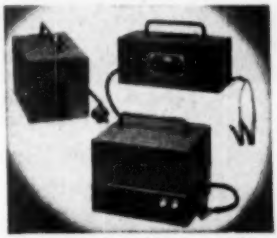
New High Fidelity Ribbon Microphone

The Trix range of amplifiers and accessories covers every possible requirement in Sound Amplification and distribution. The design and quality, backed by nearly a quarter-of-a-century's experience of Sound Engineering, will satisfy the most critical — and the equipment is well-known for its reliability in service.

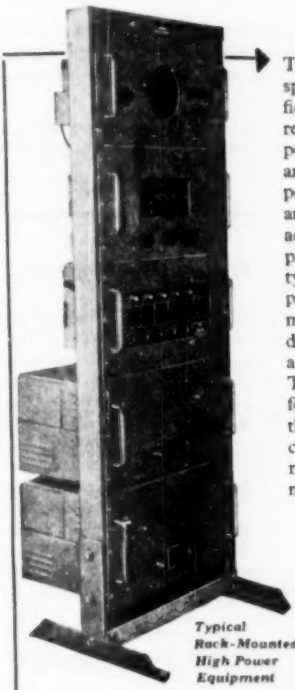
16 Watt Amplifier Model T614 (Triple tone high fidelity type)



20 Watt Amplifier Model T633B (General purpose high gain type)



Portable Battery-Mains Amplifier (Model B619)



Typical Rack-Mounted High Power Equipment

The range includes models specially designed for high fidelity gramophone record reproduction; multi purpose 3-stage high gain amplifiers; low power and portable models for mains and battery operation; and accessories including microphones, stands and all types of loudspeakers. High power rack mounted equipments are also supplied, designed to serve as many as 300 to 500 loudspeakers. The equipment is suitable for industrial installations, theatres, public buildings, churches, schools, hotels, railway stations, docks and many other purposes.

● *Write for illustrated list of full Sound Equipment Range for every type of installation.*

THE TRIX ELECTRICAL CO. LTD

1-5 Maple Place, Tottenham Court Rd., London W.1

Phone: Museum 5817 "Grams: "Trixadio, Wesdo London"

AMPLIFIERS · MICROPHONES · LOUDSPEAKERS

Wherever

Precision Measurements

must be made there is need

for an **iEi** unit of

STABILIZED POWER

With present laboratory practice considered these Pressure Supplies are designed and produced by us in differing categories of regulation, (see table under); and in groups determined by their maximum Voltage Outputs, irrespective of Load requirements.

Groups : (1) 300v. (2) 600v. (3) 1,000v. (4) 2.2kv. (5) 5,000v.

Ratg.	Reg. %	Ripple PEAK	D.C. IMP.	Stab. Week
A	.5%	3.0 mV.	4.0	±.1 V
B	.2%	1.0 mV.	.8	±.25 V
C	.04%	.5 mV.	.15	±.2 V
D	.003%	.4 mV.	.15	±.1 V

Example : **TYPE 220 :** B. includes 3 separate R.P.S.

Reg. :	(I) 220—360 v. 150 M.A.		Reg. :	0.2%	Ripple 1 mV. imp. 1.0 ohms.
	(II) 220—360 v. 75 M.A.		"	0.2%	Ripple 1 mV. imp. 1.0 ohms.
	(III) 150 v. 20 M.A.		"		Neon stabilized.
	(IV) 300 v. 20 M.A.		"		Neon stabilized.
Unreg. :	450 v. 225 M.A.			6.3	v. 8.0 Amps
	4.0 v. 8.0 Amps				

Two separate R.P.S. in one unit facilitate multiple tests.

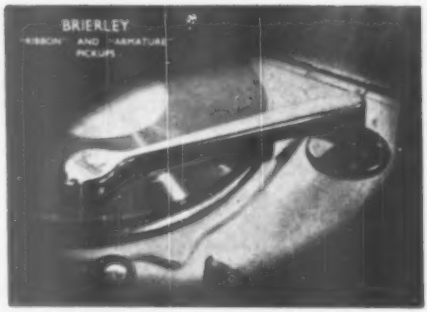
Example : **TYPE 900 :** *50 c/s ; 15 Watts ; 1 part in 100,000.*

Designers and manufacturers of all types of Stabilized Power Supplies between 100v. and 5000v. output and .5% and .003% regulation.

Write for further details specifying your special type interest.

INTER ELECTRON INDUSTRIES

7 CHILTERN STREET, W.1. Tel.: Welbeck 6029



THREE PICKUPS ARE NOW BEING PRODUCED

RIBBON MOVING COIL

AND MICROARMATURE

ALL HAVE THEIR SPECIAL APPLICATION AND FULL DETAILS WILL BE SENT ON REQUEST.

Anyone who has applied for information during the last 12 months will automatically receive a copy and is requested not to make another application immediately.

J. H. BRIERLEY (GRAMOPHONES & RECORDINGS) LTD.

46, TITHEBARN STREET, LIVERPOOL, 2.

T/V Experts agree...

that *Murphy Radio Ltd.*, have accomplished a wonderful engineering feat in the TPG11 Television Pattern Generator. A unique *portable* instrument, the TPG11 gives a test pattern with all the correct timing pulses etc., and can be used for *all* television testing, installation, fault finding and setting up IN THE ABSENCE OF A B.B.C. TRANSMISSION. The TPG11 must not be confused with cheaper types of pattern generator which do not produce the correctly timed B.B.C. synch. pulses, and are, therefore, only of limited use. The immense value of the TPG11 will be realised when one considers how much time is saved in being independent of transmission hours.

For full specifications write to :—

F. LIVINGSTON HOGG

65, BARNSBURY STREET, LONDON, N.1.

or Telephone TUDor 5277

and arrange a demonstration

F. LIVINGSTON HOGG, SPECIALIST IN HIGH GRADE INSTRUMENTS FOR THE COMMUNICATIONS INDUSTRY.

NINE EXAMPLES

from the

"FLEXILANT"

(RUBBER BONDED TO METAL)

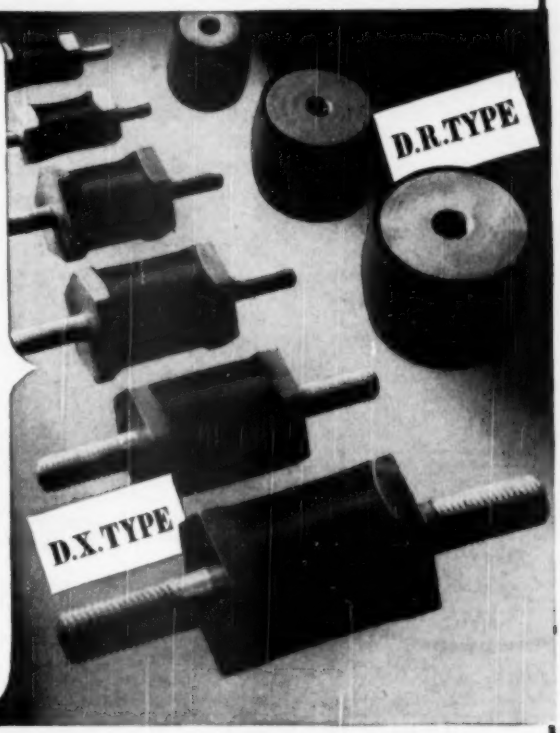
RANGE

of

MOUNTINGS

•

OBTAINABLE FROM STOCK



OUR TECHNICAL STAFF investigates all mounting problems May it investigate yours?

FLEXILANT

RUBBER BONDERS LIMITED

ENGINEERS IN RUBBER BONDED TO METAL

FLEXILANT WORKS

DUNSTABLE · BEDS.

TELEPHONE DUNSTABLE 605-6

R.B.27

WHAT CAN I DO THIS WINTER?

Well, if you know something about radio and are reasonably good with your hands, you can make yourself a Magnetic Recorder. This fascinating hobby is within your reach; using Park Radio's plans and parts you can make the recorder, including super-quality amplifier, for £20.

Recordings are made on wire or tape; they can be played time and time again without deteriorating, and when no longer required can be erased completely. In this way the wire or tape can be used over and over again.

Send 5/- now for complete Constructional Data, working drawings, and a price list of all parts.

PARK RADIO of MANOR PARK

676/8 ROMFORD ROAD, LONDON, E.12

(A division of Judge Industries)

DESIGNERS — MANUFACTURERS — AMATEURS —

For EFFICIENCY & RELIABILITY INSIST on —

'Cyldon' VARIABLE CAPACITORS

All standard laws, capacity ranges, & voltages up to 15kV.

AIR-SPACED TRIMMERS

MICA DIELECTRIC COMPRESSION TRIMMERS

VARIABLE TRANSMITTING CAPACITORS

Manufacturers: SYDNEY S. BIRD & Sons, Ltd.
Cambridge Arterial Rd., Enfield, Middx.
Phone: Enfield 2071-2

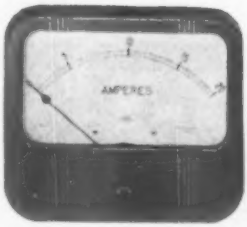
THE THREE 'R's

3", 3½", 6"
RECTANGULAR INSTRUMENTS
by
PULLIN

Series 30

Series 35

These three rectangular instruments are designed on symmetrical lines, thus giving a distinctive clear open scale and pleasing appearance. Each size available in all standard ranges. The Series 65 and 35 can be fitted with dial illumination.

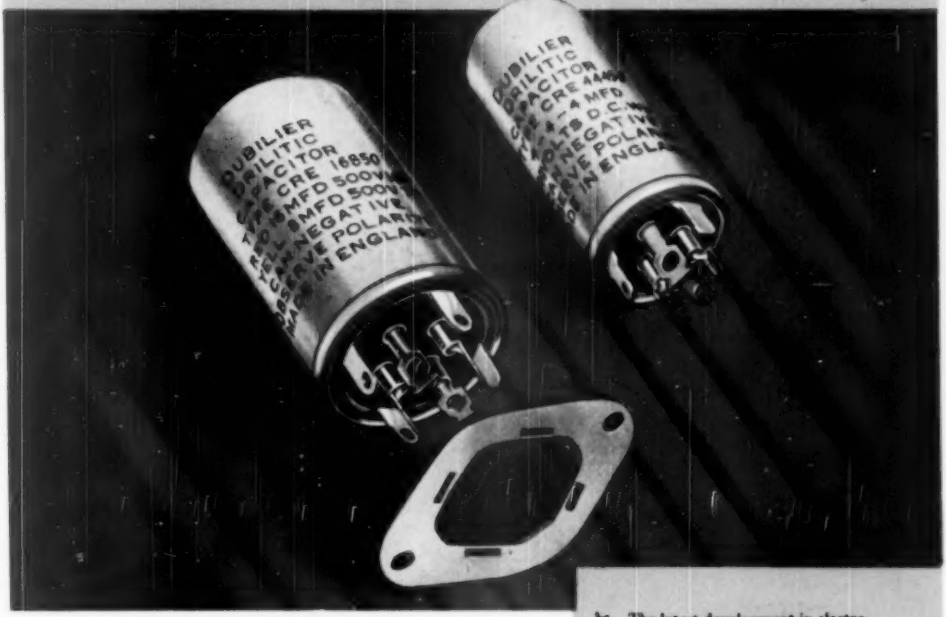


Series 65

MIP

MEASURING INSTRUMENTS (PULLIN) LTD.
Electrin Works, Winchester Street, Acton, London, W.3.
Telephone ACOrn 4651/3 & 4995

MODERN CAPACITOR MOUNTING



EAR MOUNTING DRILITIC CAPACITORS

This modern method of mounting enables the maximum advantage to be secured from the improved electrical characteristics and size reductions of Dubilier Drilitic Capacitors.

No loose parts, clamps, screws or rivets are necessary—a slight twist of the mounting ears and the capacitor is fixed. For chassis-capacitor isolation bakelite mounting plates are supplied; metal plates are available with identical centres for general replacement purposes of the older type capacitors and for interim tooling period.

Ear Mounting Drilitic Capacitors type CTE and CRE have hermetically sealed seamless drawn aluminium containers, have solder tags and are supplied in the usual capacitances and voltages.

Comprehensive catalogues giving detailed information of capacitors and technical service are available upon request.

- **The latest development in electrolytic capacitor engineering.**
- **Minimum chassis space required.**
- **Easily mounted in a few seconds.**
- **No loose parts or clamps necessary.**
- **Perfect chassis-capacitor container contact.**
- **Speedily converted to older clamp-centres mounting.**
- **Hermetically sealed seamless drawn aluminium container.**
- **Improved electrical performance and valuable size reduction. Non-corrosive all aluminium construction.**

DUBILIER
CONDENSER CO. (1925) LTD.

DUBILIER CONDENSER CO. (1925) LTD. DUCON WORKS, VICTORIA ROAD, N. ACTON W.3. LONDON, ENGLAND.
'Phone: Acorn 2241 (5 lines) *'Grams:* Hivoltcon, Wesphone, London. *Cables:* Hivoltcon, London. Marconi International Code

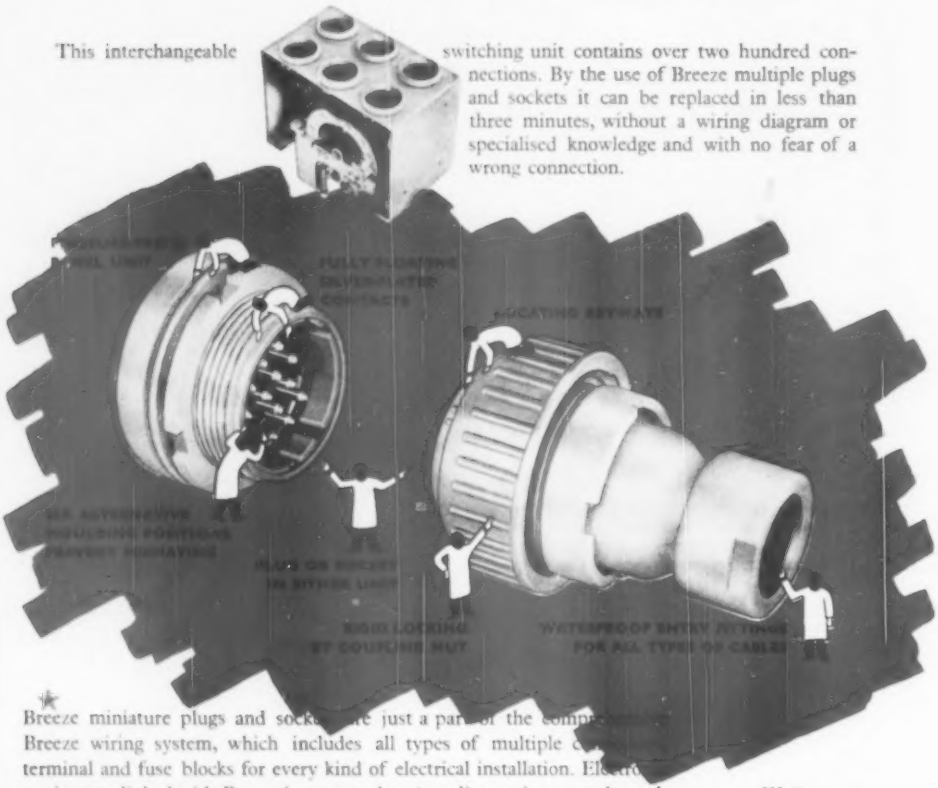
D40
C*

Breeze

MINIATURE CONNECTORS

for electronic equipment ★

This interchangeable switching unit contains over two hundred connections. By the use of Breeze multiple plugs and sockets it can be replaced in less than three minutes, without a wiring diagram or specialised knowledge and with no fear of a wrong connection.

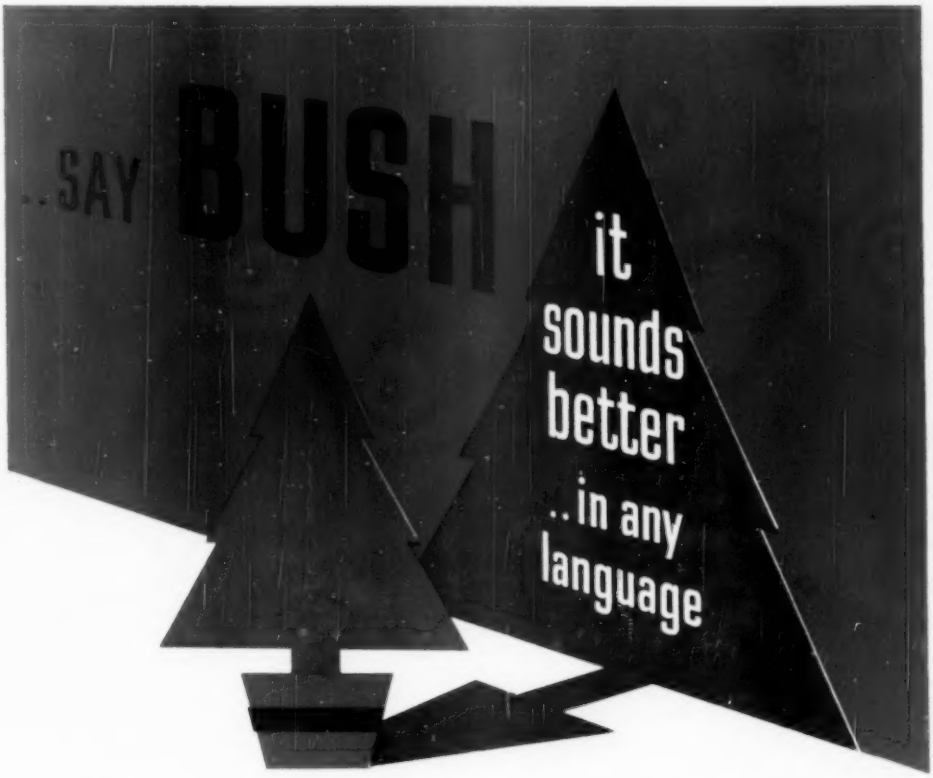


★ Breeze miniature plugs and sockets are just a part of the complete Breeze wiring system, which includes all types of multiple connectors, terminal and fuse blocks for every kind of electrical installation. Electronic equipment linked with Breeze is protected against dirt, moisture, and rough handling. Write today for an illustrated booklet describing the unique features of the Breeze wiring system, and how it can be used to add still further to the reliability of your products.

Write now for illustrated booklet

PLESSEY INTERNATIONAL LIMITED
ILFORD · ESSEX · ENGLAND

ONE OF THE Plessey GROUP OF COMPANIES



HERE'S a brand new Bush Bandspread model that is certain to win many friends in many lands, for it fully upholds the Bush standard of reliability and performance. Five wavebands give a wide selection of stations and all four short wavebands are fully bandspread. Tone-quality is superb, thanks to the special output circuit and a sensitive 8" speaker. The cabinet strikes an unusual note with its centrally mounted tuning scale and is proofed against climatic conditions. Specify EBS 15 for AC or EU 15 for DC and AC mains.

THE BUSH VIBRATOR PACK V.7.

will quickly and easily convert the EU.15 mains receiver so that it will operate from a 6 volt car battery.

BUSH RADIO

Write to:- **The Export Manager,**

BUSH RADIO LIMITED, LONDON, W.4, ENGLAND

Cables: Supasetz, London

Foyds 50-1-2

PIONEERS in CAPACITOR design and practice

HUNT'S provide a thoroughly reliable capacitor service for every need in the fields of Radio, Electronics and Industrial Electrical Equipment.

RADIO AND ELECTRONIC

DRY ELECTROLYTIC. All aluminium construction, including a new miniature tubular range.

FOIL AND PAPER. All types; tubular and metal case construction.

MINIATURE METALLISED PAPER. Hunt's patented construction, saving considerably in dimensions and weight when compared with equivalent foil and paper types. Self-healing—practically indestructible at stated voltages or occasional overload. **New development** is the moulded miniature Type W.99.

NEW MOLDSEAL TUBULAR PAPER CAPACITORS Proof against humidity—wide temperature range Miniature sizes. This latest Hunt development will be available in Miniature Metallised Paper and Foil and Paper construction. Moulded in a special material. Definite improvements over existing types of tubulars and economical in use.

MOULDED MICA. Stacked foil types.
PROTECTED SILVER MICA & STACKED MICA.

ELECTRICAL INDUSTRIAL

PAPER CAPACITORS. For P.F. improvement, capacitor start and run motors, fluorescent lighting, interference suppression, etc.

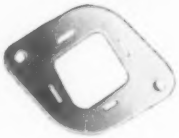
MINIATURE METALLISED PAPER. Small in dimensions, volume and weight. Self-healing characteristics. For A.C. and D.C. working.

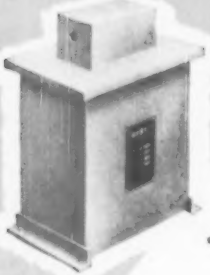
DRY ELECTROLYTICS. In a wide variety of types and with various fixing arrangements of particular interest for capacitor start motors.

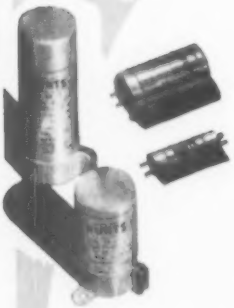
OIL FILLED TYPES. For P.F. improvement and many other industrial applications.

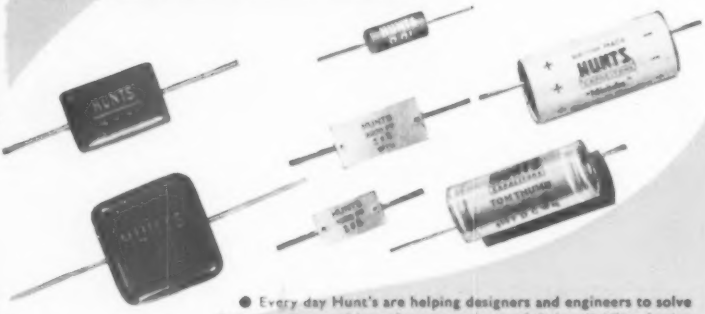
SPECIAL TYPES. Special types designed to meet specific needs.

A wide range of industrial types suitable for equipment in all climates—the result of long experience in the export field as part of a long-established policy of overseas trading. Full details and catalogues, samples and all technical information gladly supplied on request.









● Every day Hunt's are helping designers and engineers to solve their capacitor problems. Long experience of their reliability, lasting quality, performance and ease of application make Hunt's Capacitors an undisputed first choice.

A wide range of types is available—all produced with the same meticulous attention to the process of manufacture, from the selection of fine quality basic materials to careful life testing of each capacitor before leaving the factory.

Technical assistance is, of course, freely given on any specific problem.

● *There are Hunt's agents and stockists in many countries outside Great Britain. We shall be pleased to put you in touch with the nearest upon request.*

A. H. HUNT LTD
Wandsworth
London · S.W.18
England

Cables: Trimmers London
Telegrams: Trimmers Put London
Telephone: BATtersea 3131

The Trade Mark of Reliability
HUNTS
CAPACITORS
FOR RADIO · ELECTRONIC & INDUSTRIAL USES

Mullard

REVIEW OF NEW AND CURRENT VALVES

THE NEW VALVE TECHNIQUE FOR V.H.F.
Versatile, Efficient, Dependable.

For their size these valves are among the most efficient in existence, and are particularly recommended for equipments operating in the V.H.F. range. Features are small size, low drive power and small power consumption for the rated outputs.

The Triodes TY2-125, TY3-250 and TY4-500 form a series with increasing anode dissipations from 135 to 500 watts, and are designed for use as R.F. amplifiers, grounded grid amplifiers or oscillators in both communications and small R.F. Heating equipments.

The Tetrodes QY3-125 and QY4-250 are rated respectively for maximum anode dissipations of 125 and 250 watts and are characterised by high power gains and high efficiencies at very high frequencies.

TYPICAL OPERATING CONDITIONS (CLASS C TELEGRAPHY)

Type	f (Mc/s)	Va (V)	Vg2 (V)	Vg1 (V)	Ia (mA)	Ig2 (mA)	Ig1 (mA)	Vin (pk) (V)	Pout (W)	η %	Pload approx. (W)
TY2-125	150	2500	—	−200	200	—	40	350	360	72	290
TY3-250	70	3000	—	−250	373	—	70	420	850	76	680
TY4-500	70	4000	—	−350	550	—	100	625	1670	76	1330
QY3-125	120	3000	350	−150	166	35	10	280	375	75	300
QY4-250	80	4000	500	−225	312	50	8	315	970	78	780

FIRST BRITISH RANGE OF 10 mm SUB-MINIATURES — for Communications & Industry.

These sub-miniature valves are the first of a range offering special advantages where saving in space, weight and volume is of importance. The range includes battery and mains types together with voltage stabilisers. All types with the exception of the diode EA76 have round B8D glass bases in which the leads are disposed on a circle of 6mm pitch diameter.

Type	Description
DAF70	Single Diode Voltage Amplifying A.F. Pentode.
DF72	Sharp cut-off R.F. Pentode.
DF73	Variable-mu R.F. Pentode.
DL75	A.F. Output Pentode.
EA76	Single Diode. (5mm bulb)
EC70	R.F. Triode for use as Oscillator up to 500 Mc/s
EF70	High Slope R.F. Pentode.
EF72	Sharp cut-off High Slope R.F. Pentode.
EF73	High Slope Circuits Pentode.
7081	Voltage Stabiliser.

ELECTRONIC FLASH TUBES FOR INDUSTRY AND RESEARCH. The Mullard range of electronic flash tubes now comprises types specially designed for applications in industry and research. They include: Line source tubes for applications such as photographing ion tracks in Wilson Cloud Chambers; a high light intensity type of 10,000 Joules (LSD 10); a Stroboscopic Tube (LSD 8); and a 1,000 Joule silica tube (LSD 9) for use where a UV light source is required.

INDUSTRIAL THYRATRONS.

Important additions to the Mullard range of industrial thyratrons include the Mercury Vapour Triodes MT17 and MT57. On account of their high current output, small size and reliability under severe conditions of service, these new thyratrons are particularly suitable for a variety of power control applications and for use in motor speed control systems. The range of thyratrons at present available is given below:

Type	Description
MT17	0.5A Mercury Vapour Triode
MT57	2.5A Mercury Vapour Triode
EN31	Helium-filled Triode
2D21	Miniature Gas-filled Tetrode
1267	Cold Cathode Gas-filled Triode

There are Mullard valves and electron tubes for most communication and industrial requirements. Ranges include Industrial Power Valves, Industrial Rectifiers, Photocells, Accelerometers, Cathode Ray Tubes, Stabilisers and Reference Level Tubes, Cold Cathode Tubes, Electrometers, etc.

If you require full technical data on any of the valves described in this review, please check this form, pin to your letter heading and post to the address below.

V.H.F. Valves . . ☐
10mm. Sub-miniatures . ☐
Flash Tubes . . . ☐
Thyratrons . . . ☐

Signature _____

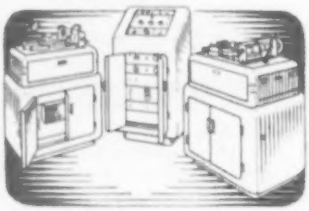
MULLARD ELECTRONIC PRODUCTS LTD., CENTURY HOUSE, SHAFTESBURY AVENUE, LONDON, W.C.2

MV166

DIRECT RECORDING ON DISK

THE year 1930 marked a vital point in sound recording progress. It was then that Mr. C. E. Watts, founder of the M.S.S. Recording Co. Ltd., produced the first cellulose lacquer-coated disk—an achievement which paved the way to—indeed made possible—to-day's high-fidelity sound reproduction. That same pioneering spirit, consistently prompting every endeavour of the M.S.S. organisation, has produced a range of sound recording equipment which is acknowledged supreme wherever there is an appreciation of true fidelity in sound reproduction. Apart from its "quality" performance, every item of M.S.S. equipment—whether a complete recording channel or a cutter head—is built to a standard of technical excellence which assures long-maintained efficiency under the most exacting operating conditions. In this connection it is interesting to mention that the first disk recorder used by the B.B.C. for broadcast programmes and supplied by M.S.S. in 1933, is still in use in their training school.

Illustrated below is a typical M.S.S. Studio Recording equipment, but the M.S.S. range includes Portable Studio Recording equipment, Portable Recorders for the professional and also home recording equipment. Full details will gladly be sent on request.



M.S.S. RECORDING CO., LIMITED
POYLE CLOSE, COLNBROOK, BUCKS
Telephone: COLNBROOK 115

Wharfedale announce

These Revised Prices effective from JANUARY 16th 1950

CHASSIS (Less transformers)

Midget, 3½in.	22/6	Golden 10in.	80/-
Five-inch W.5	24/-	Golden/C.S.B.	90/-
Standard 8in.	32/6	W.10/C.S.	145/-
Bronze, 8in.	37/-	W.12, 12in.	140/-
Super 8	70/-	W.12/C.S. 12in.	150/-
Super 8/C.S.	80/-	W.15, 15in.	230/-
Bronze, 10in.	45/-	W.15/C.S. 15in.	240/-

CABINET MODELS (Less transformers)

Bantam	42/6	Sylvan Baffle	92/6
Tyny	50/-	De-Luxe Cabinet	185/-
Bijou	79/6	Super 8/C.S. Baffle	140/-
Bronzian	105/-	W.10/C.S. Baffle	220/-
Gem Baffle	57/6	Corner Cabinet	970/-

FACTORY MODELS 3 or 15 ohms.

Factory/Bronze	102/6
Factory/Golden	130/-
Factory/W.12	230/-

W.15/C.S. CORNER ASSEMBLY

Non-resonant Sand-filled Panel, with ¾in. top, in Walnut, Oak, Mahogany	£26 10 0
Complete with W.15/C.S. Separator and W.10/C.S. Baffle	£52 5 0
Or with Super 8/C.S.	£48 5 0

SEPARATORS

Type A for 7 to 15 ohms	*65/-
Type B for 7 to 15 ohms	†55/-
Type C for 2 to 6 ohms	*85/-
Type D for 2 to 6 ohms	†75/-

* Terminals. † Tags.

TRANSFORMERS

O.P.3	6/6	De Luxe	22/6
P. Type	7/2	W.12	21/-
G.P.8	11/6	W.12 Ratios to order	25/-
Universal	13/6	W.15 Ratios to order	60/-

Prices of Sundries and School Models remain as catalogue.
Some cheaper models have been reduced in price, but owing to the rise in cost of magnets, prices of better quality models have been increased.

WHARFEDALE WIRELESS WORKS
BRADFORD ROAD, IDLE, BRADFORD, YORKS

BUILD YOUR OWN TELEVISION RECEIVER *THE EASY WAY*

"VIEW MASTER"

(London or Birmingham)

All specified components can be supplied from stock. W.B. components including fitted chassis, mains transformer, choke and speaker £6 5 0
Complete set of Morganite resistors £1 6 9
Complete set of T.C.C. condensers £6 15 0
Complete set of Bulgin tag strips, switch, etc. 12 6
Complete set of Westinghouse rectifiers £3 2 6
Complete set of Belling & Lee mains unit 7 6
Complete set of Colvern Potentiometers 19 3
Complete set of Wearite coils £1 0 0
Plessey frame transformer 72001 ..... 18 6
Plessey line output transformer 72000 ..... £1 1 3
Plessey seaming coil 72003 ..... £1 5 6
Plessey focus ring (triode) 72004 ..... 19 6
Plessey focus ring (tetrode) 72005 ..... 19 6
Plessey boost choke 72006 ..... 5 0
Plessey C.R.T. supports front and back, 72007 ..... 14 0

Send for complete instructions together with complete Price List, 5/6, post free.

Shop hours: Monday-Saturday, 9-6 p.m.; Thursday 9-1 p.m.

TELE-RADIO (1943) LTD.

177A, EDGWARE RD., LONDON, W.2
Phone: PAD 6116. PAD 5606.

CINTEL

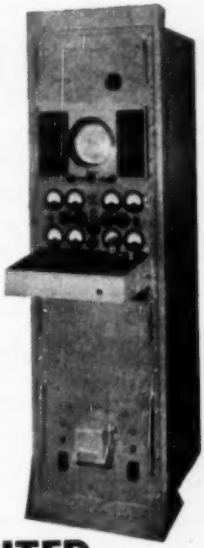
Heralding the latest advancement in electronic equipment

SQUARE WAVE GENERATOR

This instrument provides a square wave of amplitudes from 5mV to 50v peak to peak calibrated, at a repetition frequency of from 5c/s to 150Kc/s. The mark/space ratio is 1 : 1 and the wave is flat to within less than ±1% top and bottom. Alternative positive and negative pulses of 0.05, 0.1, 0.2, or 0.3μSecs can also be obtained with amplitudes of from 5mV to 5v peak to peak.

UNIVERSAL VALVE TESTER

This instrument will display on a cathode ray tube the Anode volt/Anode current curves for any receiving type valve. Curves for eleven different grid voltages are shown simultaneously and a calibration pattern is displayed enabling the voltage and current characteristics to be checked.



For further particulars—please write to :—

CINEMA-TELEVISION LIMITED

FOREMOST IN THE MANUFACTURE OF

• Counters & Chronometers • Metal Detectors • Oscilloscopes • Photo-Electric Cells • Cathode Ray Tubes • Geiger-Muller Tubes • Electronic Instruments

WORSLEY BRIDGE ROAD · LONDON · S·E·26

Telephone: HITher Green 4600

Northern Agents:
F. C. ROBINSON & PARTNERS LIMITED
308 Deansgate, Manchester 3

Scottish Agents:
ATKINS, ROBERTSON & WHITEFORD LIMITED
100 Torrisdale Street, Glasgow, S.2

CINTEL

REGISTERED TRADE MARK

SEEING IS BELIEVING

AMBASSADOR

TELEVISION IS YOUR CHOICE

In Great Britain and America the styling of the Ambassador TV.2 Television Receiver has been acknowledged as being the most outstanding yet seen in Television.

In performance it is equally so. Unique circuit technique has given important advantages including tight interlace with positive frame and line lock through severest interference.

These circuits are exclusive to Ambassador and are the subjects of patent applications.

STYLED AND PRODUCED BY

AMBASSADOR OF GREAT BRITAIN REGD

Regd. Design No. 859761

MODEL TV.2, £69 10 0 TAX PAID. A.C. ONLY.
15 VALVES, 12" C.R.T.
Obtainable only through specially appointed Agents.
Sales Dept., Brighouse, Yorkshire. Tel. : 1280 P.B.X.

WEYRAD

Components for all users. If you are interested in these or any other items please write for further details.

BANDSPREAD UNITS—Ranges to suit all requirements—9 Wavebands—with or without R.F. stage.

TUNING SCALES NOW AVAILABLE. Size 9in. x 9in.

COIL PACKS—3 and 4 Waveband with R.F. stage. 3-Wave packs—Special versions for battery operation.

COILS—12.5 to 2,000 Metres. Air cored, Iron cored midget and Screened types available.

I.F. TRANSFORMERS—Miniature, Midget and Standard types, all of high performance.

FILTERS, CHOKES AND SPECIAL COILS to order. We are coil winding and assembly Contractors to well known manufacturers at home and overseas. Your enquiries, large or small, are invited.

WEYMOUTH RADIO MANUFACTURING CO., LTD.,
CRESCENT STREET, WEYMOUTH

SRC

SILVERED MICA CAPACITORS

SMALL SIZES
HIGH STABILITY
CLOSE ELECTRICAL LIMITS

STABILITY RADIO COMPONENTS LTD

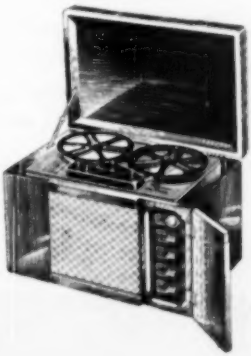
14, NORMAN'S BUILDINGS,
CENTRAL STREET, LONDON,
E.C.1
TELEPHONE: CLERKENWELL 8977

21 candles round the cake—the family gathered round the long table—and in a corner of the room, the Soundmirror, its sensitive microphone recording on reels of inexpensive magnetic tape all the fun and laughter of a once-in-a-lifetime event.

With this remarkable new Instrument you can make your own home sound recordings—the best music—the greatest drama, speeches, sports events, etc.

Made in England.
Protected by British and Foreign Patents and Patents Pending.

- **Anyone can operate the Soundmirror. One single finger-tip control provides for Play, Record, Rewind or Fast forward requirements.**
- **Recordings can be played back at once.**
- **Recordings may be permanently retained, or old items erased as new recordings are made.**
- **Sound Library. You can build your own Sound Library of Music, Speeches, Talks or family events—Birthdays and Weddings, etc.**



Full details from the Manufacturers or Demonstrations by Appointment.

THERMIONIC PRODUCTS LTD.

MORRIS HOUSE, JERMYN STREET, HAYMARKET, LONDON, S.W.1

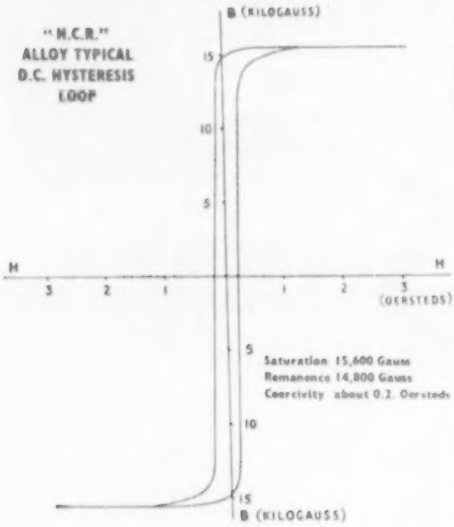
Telephone: Whitehall 6422 (5 lines)

Sales and Service Centres: *MANCHESTER · BIRMINGHAM · BRISTOL · LEEDS · ETC*

TELCON'S LATEST MAGNETIC DEVELOPMENT

H.C.R. ALLOY

is now available in commercial quantities



The magnetic properties of this alloy make it suitable for mechanical rectifiers, magnetic amplifiers and special forms of reactors.

TELCON Founded 1864

Full technical details on request from :—

THE TELEGRAPH CONSTRUCTION & MAINTENANCE CO. LTD.
Founded 1864
Head Office: 22 OLD BROAD ST. LONDON E.C.2 Tel. LONdon Wall 3141
Telegrams: TELCON-WORKS GREENWICH S.E.10 Tel.—Greenwich 3291

★ GOOD NEWS

for Gramophone Enthusiasts!

GREAT REDUCTION IN PRICES

OF ROTHERMEL CRYSTAL PICK-UPS

As and from January 1st, 1950, the prices of the famous Rothermel Crystal Pick-ups are greatly reduced. The cost of even the more expensive models is now within the price limit of the most slender purse, and the superb performance of these high-class instruments can now be enjoyed by all. The demand is bound to be heavy, so make your choice and secure now.

	Old Price	New Price
SENIOR MODEL	45/-	28/-
S.8 MODEL - -	42/-	26/-
S.12 MODEL - -	42/-	26/-
U.48 MODEL - -	25/-	19/6

Purchase Tax extra

If you have any difficulty in obtaining supplies from your retailer, write direct to:—

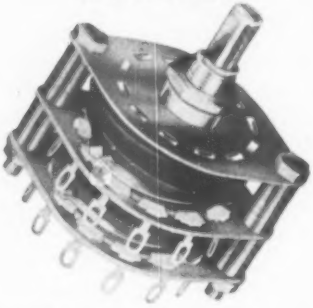
R.A.ROTHERMEL LTD.

ROTHERMEL HOUSE,
CANTERBURY ROAD, KILBURN, LONDON, N.W.6

Telephone: MAIDA VALE 6066 (3 lines)

TAYLOR SWITCHES

TYPE 970

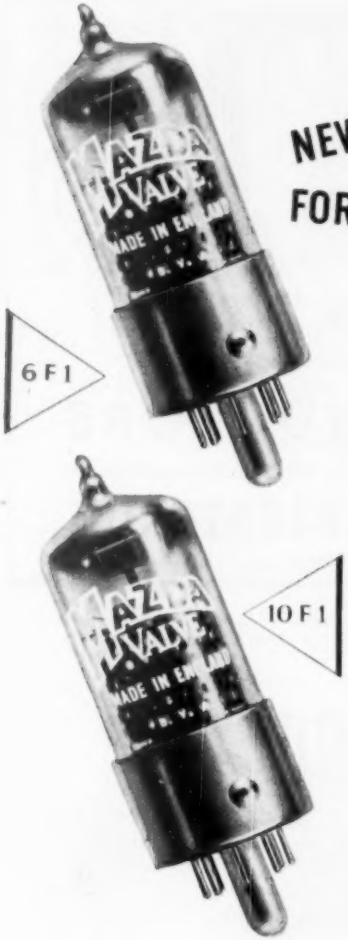


Designed for radio, electronic, or instrument use with 12 or 18 way decks. Robust, reliable and trouble free.

- **CURRENT RATING.** Shorting type 10 amps. Non shorting 5 amps.
- **LOW CONTACT RESISTANCE.** Shorting type ·001 ohm, non shorting ·002 ohm.
- **COMPACT.** Occupies panel space only $1\frac{1}{2}$" x $2\frac{1}{32}$".

Details of all Taylor Components sent on request

TAYLOR ELECTRICAL INSTRUMENTS LTD
419-424 MONTROSE AVE., SLOUGH, BUCKS, ENGLAND
Tele. SLOUGH 21381 (4 lines) Grams & Cables TAYLINS SLOUGH



NEW SCREENED H.F. PENTODES FOR THE TELEVISION FREQUENCIES

The 6F1 and 10F1 are two new screened H.F. Pentodes for AC and AC/DC mains operation respectively. Identical, apart from heater rating, they have twin cathode connections giving a considerable reduction in common anode and grid circuit H.F. impedance, thereby enabling a high input resistance to be obtained.

This high input resistance together with the high mutual conductance of these valves (9mA/V at 10mA Anode Current) makes them ideal for use in straight television receivers, particularly for operation at a carrier frequency of 61·75 Mc/s as used by the Midland (Sutton Coldfield) transmitter.

TYPICAL OPERATION

		6F1	10F1
Heater Voltage	V_h	6.3 volts	22 volts
Heater Current	I_h	0.35 amps	0.1 amps
Anode Voltage	V_a	200 volts	200 volts
Screen Voltage	V_{g2}	200 volts	200 volts
Anode Current	I_a	10 mA	10 mA
Screen Current	I_{g2}	2.6 mA	2.6 mA
Grid Voltage	V_{g1}	−1.8 volts	−1.8 volts
Mutual Conductance	g_m	9 mA/V	9 mA/V
Input loss at 61.75 Mc/s (approx.)	r_{in}	7500 ohms	7500 ohms

BASE B8A. **LIST PRICE: 15/6d**

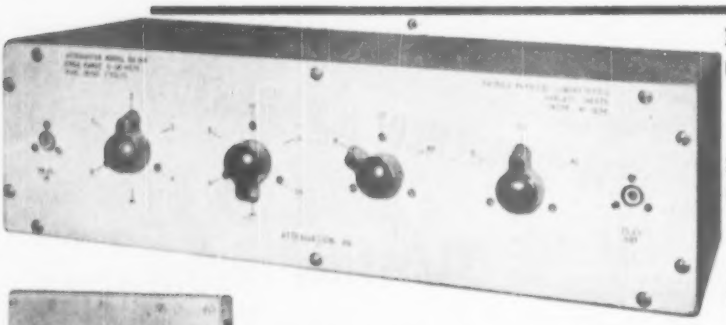
EDISWAN

MAZDA

RADIO VALVES AND TELEVISION TUBES

THE EDISON SWAN ELECTRIC CO. LTD., 155 CHARING CROSS ROAD, LONDON, W.C.2

RA194



FIXED PADS
UP TO 60 db

★

STEP TYPE
UP TO 100 db

★

ACCURACY 1%
D.C TO 50 Mc/s

AN ENTIRELY NEW
RANGE OF

CO-AXIAL ATTENUATORS

For particulars of these and our full range of measuring instruments, write to :—

BRITISH PHYSICAL LABORATORIES

HOUSEBOAT WORKS · RADLETT · HERTS · Telephone : RADlett 5674-5-6

"STEWART"

HIGH GRADE TRANSFORMERS

Types Available for Delivery ex Stock

ANY OTHER SPECIFICATION TO ORDER

Primaries tapped 210-230-250v.

Type No.	Secondaries						Price
X2	260-0-260v	65 m/a	6.3v 2a	5v 2a			27 6d.
A6 A4	350-0-350v	75 m/a or	6.3v 3a 4v 4a	5v 2a 4v 2a			28 6d.
B6 B4	350-0-350v	100 m/a or	6.3v 3a 4v 5a	5v 2a 4v 2a			34 6d.
C6 C4	350-0-350v	150 m/a or	6.3v 4a 4v 6a	5v 3a 4v 2.5a			46 6d.
S/28/1**	425-0-425v	200 m/a 5v 3a	6.3v 4a 6.3v 2a				70 -d.
S/28/2*	350-0-350v 0-4-5v 3a	250 m/a 0-2-6.3v 2a	6.3v 6a 4.0v 8a				90 -d.
S/28/3	350-0-350v	250 m/a 0-2-6.3v 2a	6.3v 7a 5.0v 2a				82 6d.
S/24/1 S/24/2 S/24/3	1000v 1750v 2500v	10 m/a 10 m/a 10 m/a	0-2-4v 2a 0-2-4v 2a				40 -d. 45 -d. 55 -d.
S/24/4* S/24/5*	4000v 5000v	5 m/a 5 m/a	0-2-4v 2a 0-2-4v 2a				63 -d. 75 -d.

* For "Electronic Eng." Televisor.
** For The "Williamson" Amplifier.

STEWART TRANSFORMERS Ltd.
1021 FINCHLEY RD., LONDON, N.W.11
Tel.: SPEdwell 3000 and 2533

ACRU

neon indicator lamps

ONE-HOLE FIXING

In handsome Black Bakelite holder complete with series resistance and leads, to show Pink, Red, Amber or Green, on 230v or 400v AC or DC. Specially designed for easy assembly in ½-inch mounting hole.

Send now for full details, prices and terms.

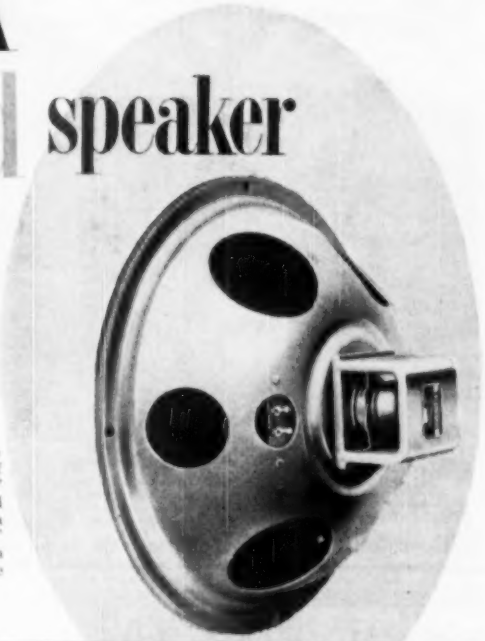
For
SWITCHBOARDS,
INDICATOR PANELS,
MACHINE CONTROLS,
HEATING APPLIANCES
ETC.

THE ACRU ELECTRIC TOOL MFG. CO. LTD.
123, Hyde Road, Manchester, 12.
Ardwick 4284.

N.L.

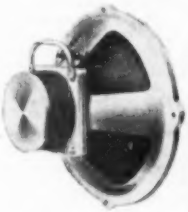
TRUVOX
the balanced speaker

fidelity of response speaks for itself to the discriminating ear. Precision manufacture is no less eloquent to the trained engineer. These qualities make TRUVOX speakers famous.



C.P.M. 12" SPEAKER. The outcome of intensive development by specialist engineers, the method of construction employed in the Truvox "C.P.M." series offers a notable economy in size, weight and cost. Ranging from "midgets" to auditorium speakers, each model in the TRUVOX "C.P.M." series is precision-designed to combine maximum flux density with the widest frequency coverage for its size.

Model BX11



12" HEAVY DUTY. Rigid die-cast chassis; square casting for the magnet seating, secured with large hexagon head bolts; centre pole and bottom plate all in one forging; ring-clamped cone; die-cast centring ring; practical construction matched by excellent response and high sensitivity—all made for HEAVY DUTY.

Response 55-11,000 C.P.S.; flux density 13,000 Gauss; powerhandling capacity 10 watts (A.C.)

Model SS10A

6½" WAFER. Wherever the requirements call for minimum space, minimum weight, robustness and normal sensitivity and response, Truvox "Wafer" speakers are the answer. Designed by specialists with twenty years' pioneering experience in loudspeaker manufacture, they are the outcome of a completely fresh approach to the problems of speaker weight and size in relation to efficiency.

Designers and manufacturers of personal and television receivers, car radio, and intercommunication equipment, and all other users needing real compactness, will find the "Wafer" speaker range of superlative interest.

Model BS1650

MONOBOLT. Unshakably rigid in transit and extended use, the unique construction of Truvox "Monobolt" loudspeakers gives unequalled reliability and consequent freedom from service troubles. The use of a one-inch pole-piece allows large power handling capacity free from distortion.

Model BX82 8" **Model BX102 10"**

Full technical details of all Truvox Speakers available on request.

Your local dealer can supply you with Truvox.

TRUVOX ENGINEERING CO. LTD., EXHIBITION GROUNDS, WEMBLEY, MIDDX.

"JUNO" and "OCO" floor polishing machines are also manufactured by TRUVOX. Send for details.

TX71A

THE RADIO TELEPHONE YOU CAN TUCK UNDER THE DASH

B.C.C. V.H.F.

RADIO TELEPHONE EQUIPMENT

The B.C.C. Mobile Radio-Telephone illustrated here will give two-way communication with the Fixed Station up to a distance of 25 miles or with the portable Pack-set up to 5 miles.

This B.C.C. equipment sets a new standard in V.H.F. Communications Technique and has been approved by the G.P.O. and Home Office. The complete range consists of:

Fixed Stations ...Models L111 & H111
Mobiles ... ...Models L67 & H67
Pack Sets ... ...Models L45V & H45V
Hand Portables ...Models L45AV & H45AV

This equipment can be supplied to cover any spot frequency in the 75-100 Mc/s or 150-185 Mc/s bands.

Write now for full details and outstanding features of this remarkable equipment.

bcc

NOTE THESE FEATURES

Size T/R. 11½in. × 8in. × 4in. (30 cm. × 21 cm. × 10 cm.) Power Pack 8in. × 5½in. × 3½in. (21 cm. × 14cm. × 8cm.) Weight T/R 15½ lbs. (7kg.). Power Pack 9½ lbs. (4.2kg.)

The Transceiver is easily installed below the instrument panel with the small power pack in any convenient place. The remarkably low battery drain permits connection of the set to the car batteries, obviating the cost and weight of auxiliary accumulators or larger dynamo

BRITISH COMMUNICATIONS CORPORATION LTD. Gerden Avenue, Stanmore, Middlesex. Tel. GRImsdyke 1455

NEW FOR 1950

BUILT BY CONVERSION EXPERTS FOR THE DISCRIMINATING USER

A CONVERTER

type 230/110, with D.C. Input 200/250 volts giving an A.C. Output of 200/250 volts. Frequency 50 cycles at 110 watts Maximum load. £10.15.0

BY VALRADIO

Who want you to know that an A.C. operated Radio, Radio-gram or Amplifier give by far the Best Results.

Literature upon request, also for Rectifiers, Frequency and Voltage Changers.

VALRADIO LIMITED

57, FORTESS ROAD, LONDON, N.W.5

GULliver 5165

High Fidelity Reproduction.

Type "K"

The S. G. Brown Type "K" Moving Coil headphones, with the following outstanding characteristics, supply that High Fidelity Reproduction demanded for DX work, monitoring and laboratory purposes, etc.

CHARACTERISTICS.

D.C. RESISTANCE, 47 Ohms.

IMPEDANCE 52 Ohms. at 1,000 c.p.s.

SENSITIVITY, 1.2 x 10-⁴ Watts at 1kc. = .0002 Dyne cm²

Descriptive Literature on request

PRICE £5.5.0 PER PAIR

Your Local Dealer can supply

For details of other S. G. Brown Headphones (prices from 30/- to 77/6) write for illustrated Brochure "W.W."

HEADPHONES WHICH UPHOLD BRITISH PRESTIGE

Telephone: Watford 7241

S.G.Brown, Ltd.

SHAKESPEARE STREET, WATFORD, HERTS.

WESTERN BALL MICROPHONE

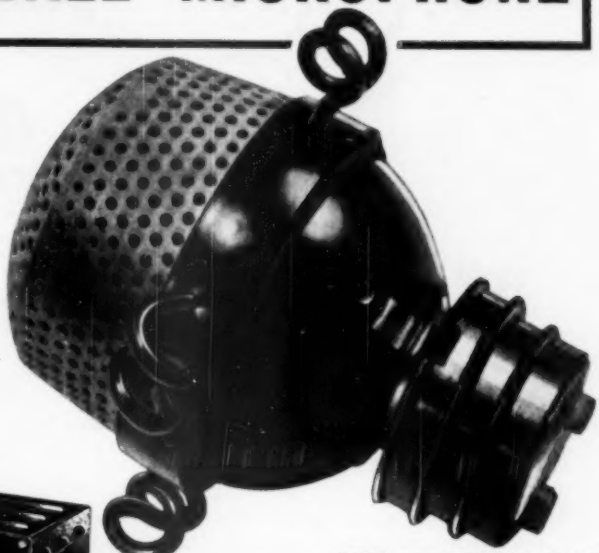
Manufactured by . . .

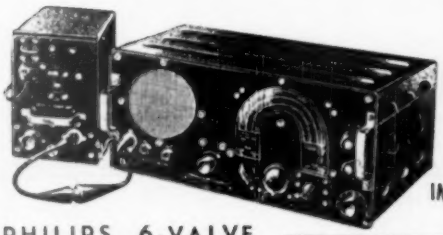
STANDARD ELECTRIC

All in perfect condition

Suitable for broadcasting and recording. Moving Coil (Dynamic). Omni-directional. No energising necessary. High Fidelity. Coil Impedance 15 ohm. and will work very well in conjunction with an ordinary speaker transformer.

Is of the type used by many leading bodies, such as the B.B.C. and G.P.O. for high fidelity reproduction. **£4.17.6**





GOVERNMENT SURPLUS IMMEDIATE DELIVERY FROM STOCK

PHILIPS 6-VALVE COMMUNICATIONS RECEIVER

16-50, 200-550 and 800-2,500 metres. R.F., F.C., 2 I.F.s. D.D.T. Pentode Output. Spin wheel tuning. In black metal case with built-in speaker. Complete with power pack, AC 200-250 v. Can also be supplied with 12 v. D.C. power pack if required. BRAND NEW EX GOVT. **£17.10.0**

Brand New ACCUMULATORS

Complete in strong case, as illustrated. British made, ex. Sta. Size 12x9x7 in. Weight 45 lb. **£3,10,0**

Fractional H.P. AC MOTORS

Converted from ex-Govt. Generators

Brush type 229-250 v. 50 cycles approx. 5,000 r.p.m. Overall diam. 10 × 4in. ½in. spindle extends 1in. both ends. **21/-**

R.A.F. 5-VALVE

SUPERHET RECEIVER

UNIT No. 25

All valves guaranteed. This unit is easily adapted to Short-wave reception for home use. In addition to two EF36, two EF39, one EK32 and one EBC33 valves, it contains 1 pr. 460 Kc/s iron dust I.F. Transformers, Mic. and phone output transformers, a number of resistances and fixed condensers of useful values, two 1 mfd. 500 v. wkg. and four .1 tubular condensers, pot'meters, Int. Octal Valve holders, Tuning Coil, etc., mounted on steel chassis 8½ × 6½ × 2½in. FREE circuit diagram 9in. × 19in. showing all components, supplied with each set. In new condition. **22/6**

HEADPHONES. Low resistance with headbands, new, **4/6** pair. New Avon, lightweight, fitted type, 90 ohms, no headbands, **3/9** pair. American lightweight. Suitable for deaf aid. **7/6** pair.

BLOWER MOTORS. 12-24 v., and 80 v., **15/-** each.

6-VOLT VIBRATORS. Type KT66. These 7 pin self-rectifying vibrators have an output of 200 v. at 60 mA. Made by Electronic Laboratories Inc. **7/6**

CATHODE RAY TUBES

12in. VCR140 Blue Screen. **90/-**. New VCR97. **37/6**.

MOVING COIL HAND MICROPHONE. Complete, **5/6**.

INSERTS, as above, **2/9**.

7-VALVE U.H.F. RECEIVER. Type R1167A. Range approx 200 megacycles with 4 Acorn valves. A Real Opportunity. Beautifully constructed and fitted with micro-condenser drive. Valve types: two EF36, one EBC33, three 954, one 955. In black metal case, 8 × 7 × 6in. Set complete with valves. **30/-**.

PLEASE NOTE.—All carriage paid unless otherwise stated. ● Carriage charges relate to British Isles only. ● We do not issue lists or catalogues.

See previous issues for other Bargains.

EX-R.A.F. TUNING UNIT

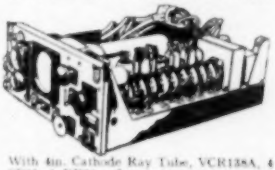
TYPE 297a

BRAND NEW. Includes Clystron valve, 3 Neon tubes CV71, 1 5Z4G and other useful components. As illustrated, plus metal cover. **21/6**

WALKIE-TALKIE (Transmitter and Receiver) CHASSIS

including four ARP12 valves. In metal case. Complete with components, except the Send/Receive switch and the ATP4 valve. Price **20/-**

TYPE 73a VISUAL UNITS



With 4in. Cathode Ray Tube, VCR138A, 4 SP61, 1 EB34 valves, potentiometers, etc. Complete on chassis, 16 × 12 × 5in. **35/-**

MAP READING TORCH

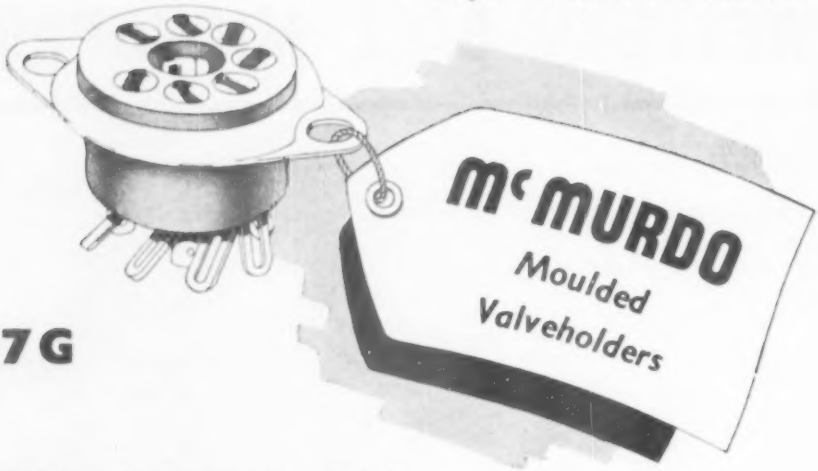
Powerful magnifying lens, 3in. diam. In bakelite case. Fitted with dimmer switch. Takes 3 U2 cells. With bulb, less batteries. **22/6**

LONDON CENTRAL RADIO STORES

23 LISLE STREET, LONDON, W.C.2

Closed Thursday 1 p.m. Open all day Saturday and weekdays 9 a.m.—6 p.m. **Tel: GERrard 2969**

Recognised as the Most Reliable Valveholders



B7G

Ref. No. **BM7/U** moulded in **Phenol-Formaldehyde**

Ref. No. **FM7/U** moulded in **PTFE**

THE McMURDO INSTRUMENT COMPANY LTD., VICTORIA WORKS, ASHTEAD, SURREY · ASHTEAD 3401

Stars for Sale!

SPECIFIED T.V. PARTS from stock

T.C.C. CONDENSERS

.5μF 20% ceramic		SCT4	1/-
10μF 10%	do.	SCT1	2/6
10μF 20%	do.	SCD1	1/3
40μF 10%	do.	SCT1	2/6
40μF 20%	do.	SCT1	1/9
4μF 20%	do.	SCT1	1/9
500 pF	microdisc	CM30	1/6
.0001	mica	CM20	1/2
.0002	do.	CM20	1/2
.001	do.	CM20	1/9
.01	Metalmite	CP119W	2/2
.002	do.	CP0[illegible]	1/9
.002	do.	CP[illegible]	1/10
.01	do.	CP[illegible]	1/10
.01	do.	CP32N	1/6
.015	do.	CP32N	2/-
.02	do.	CP32N	1/9
.02	do.	CP37N	2/1
.1	do.	CP37N	2/3
.1	do.	CP36H	2/2
.25	Metalpack	CP48N	2/8
.01 500v.	Tubular	343	11
.1 500v.	do.	343	1/3
.01 7KV	Gelbestray	CP32QO	4/6
.001 12KV	do.	CP34VO	7/6
.01 8KV	do.	CP36QO	7/6
1.7KV	do.	CP34QO	15/-
1.500v.	Plumpack	CE30N	2/6
2.500v.	do.	CE30H	2/6
10.15v.	do.	CE30B	2/6
8.400v.	Micropack	CE19P	4/6
16.750	Lectropack	CE28L	4/9
32.150	do.	CE29L	6/6
32.450	do.	CE37P	10/-
32+32.450	do.	Televisor	13/-
40.350	do.	CE19L	7/6
250.50	do.	CE10D	13/6
250/3	do.	CE35AA	8/9

MORGANITE RESISTORS.

Type T midget (¼w. 20%)	4/
Type T midget (¼w. 10%)	9
Type R midget (½w. 20%)	6
Type R midget (½w. 10%)	9

RELIANCE POTENTIOMETERS.

Type TW wire-wound 10%. 50K, 1K, 2K, 2.5K, 5K, 10K, 20K, 50K	4/6
Type TW 100K	5/-
Type SG carbon 100K, 0.5Meg.	5/-

EGEN POTENTIOMETERS.

All values less sw. 2½in. shafts	2/9
All values with sw. 2½in. shafts	4/6

SI ELECTROLYTICS.

4μF	cardboard tubular	350v	2/8
8μF	do.	do.	3/2
16μF	do.	do.	4/7
8+8μF	do.	do.	4/9
8+16	do.	do.	6/1
16+16	do.	do.	6/11
8μF	vertical	can 500v	3/9
16μF	do.	do.	4/9
8+8	do.	do.	5/-
16+16	do.	do.	8/6
1.5KV	moulded	tubular	6/-

Also Coils, transformers, valves, C.R.T.s, rectifiers, fuses and mounting coils, F.M. tuner units, masts, leads, as specified for "W.W.", "E.E.", "P.W.", Dewar and Viewmaster TV designs.

"Viewmaster" envelopes, Midland version now available, 5/- and 6d. post.

Satisfaction guaranteed. All goods post free over £1.

PHONE 58977

Smith's RADIOCRAFT Ltd

60-71 CHURCH GATE LEICESTER

Cross CMHY1 G2RI

COIL PACKS

Improved performance at lower price with the new F. P. series. 3 and 5 waveband models with or without R. F. stage.

VALVE TESTER

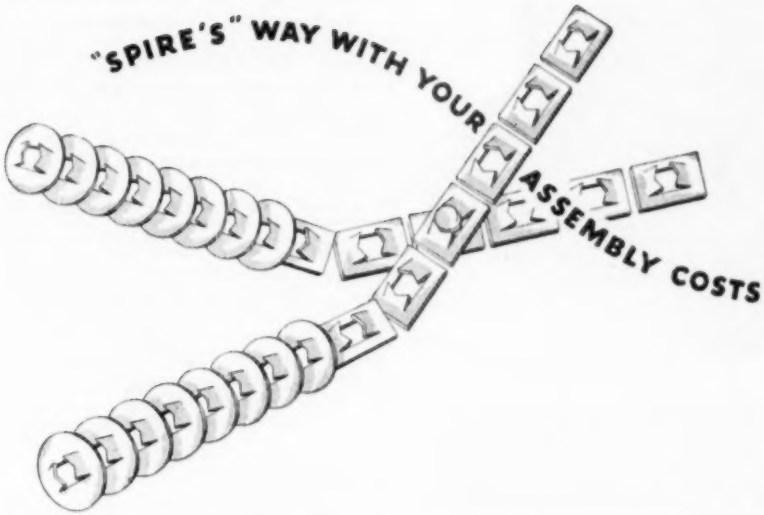
Type 218 for the Laboratory and Service Engineer

Full particulars from :—

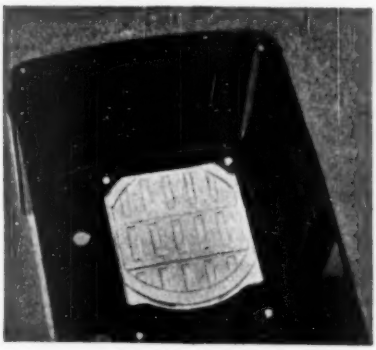
H. C. ATKINS LABORATORIES

32 CUMBERLAND RD., KEW GARDENS.

Telephone—RIChmond 2950.



Keeping assembly cost DOWN (and at the same time keeping assemblies safely together) can be a major production headache. Spire Speed Nuts answer that requirement. And many others as well. Acting on its own double-spring locking device, each Spire nut is speedier to put on, holds tighter when it's home. Awkward fixings and blind assemblies are tackled with equal ease by Spire. Sometimes threaded members can be eliminated altogether. Will you write for more information on Spire Speed Nuts—the fastest thing in fastenings?



Spire
Regd.

SPEED NUTS

The mounting of this loudspeaker grille is achieved by the use of "Push-On" Type Spire Fixes on integral unthreaded moulded studs. Inserts eliminated; moulding costs reduced; assembly is REALLY FAST.

that's fixed that

Enquiries to:—
SIMMONDS AEROCESSORIES LTD. BYRON HOUSE 7-8-9 ST. JAMES'S ST. LONDON S.W.1
HEAD OFFICE AND WORKS: TREFOREST, GLAMORGAN

13

Video Oscillator

Type. O.221 7 Kc/s - 8 Mc/s

Amplitude range of adjustment ± 10db to—55db on 1 volt peak to peak, adjustable—0.5db steps. Amplitude constant to ± 0.5db at any frequency setting. Harmonic content better than 40 db below fundamental—output impedance 75 ohms ± 5%.

The instrument is built to meet a specification of the Design Department of the B.B.C. It can be mounted to a standard G.P.O. 19" rack or alternatively is supplied with a light transportable case as illustrated.

Wayne Kerr

THE WAYNE KERR LABORATORIES LIMITED
NEW MALDEN, SURREY. PHONE: MALDEN 2202

PLEASE tell us of OTHER applications

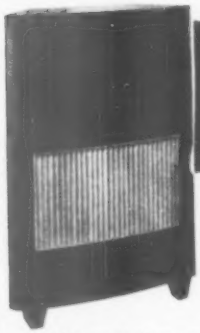
Drayton 'Hydroflex' Metal Bellows are an essential component part in Automatic coolant regulation . . Movement for pressure change . . Packless gland to seal spindle in high vacua . Reservoir to accept liquid expansion . . Dashpot or delay device . . Barometric measurement or control . . Pressurised couplings where vibration or movement is present . . Dust seal to prevent ingress of dirt . . pressure reducing valves . . Hydraulic transmission . . Distance thermostatic control . . Low torque flexible coupling . . Pressure sealed rocking movement . . Pressurised rotating shaft seals . . Aircraft pressurised cabin control . . Refrigeration expansion valves . . Thermostatic Steam Traps . . Pressure amplifiers . . Differential pressure measurements . . Thermostatic operation of louvre or damper.

for HYDRAULICALLY FORMED

Seamless, one-piece, metal bellows combining the properties of a compression spring able to withstand repeated flexing, a packless gland and a container which can be hermetically sealed. Made by a process unique in this country, they are tough, resilient, with a uniformity of life, performance and reliability in operation unobtainable by any other method.

Drayton METAL BELLOWS

Write for List No. N800-1 DRAYTON REGULATOR & INSTRUMENT CO. LTD., WEST DRAYTON, MIDDLESEX. West Drayton 2611 8.8



Richard Allan
PRESTIGE CONSOLE SPEAKER

Console Extension Speaker with continuously variable constant Impedance Volume Control.

In Walnut as illustrated £12 19s. 6d. TRANSFORMER 25 - Extra. DIMENSIONS. 32½" x 22½" x 8½".

- 10" Die Cast Chassis.
- 1½" Diameter Centre Pole.
- Critical Dimensions To .0005"
- Completely Dust Proof Assembly.
- Impedance 4 ohms at 400 c.p.s.
- Peak input 8 watts.
- Flux Density 14,000 Lines per sq. cm.
- Total Flux 82,000 lines.
- Bass Resonance 65 c.p.s.
- Self aligning Magnet Assembly.
- Special Curved cone is highly damped by the field provided by a 2 lb casting of Alcomax II.
- Level response from 60 to 9,500 c.p.s.

RICHARD ALLAN RADIO LTD.
BAFFLETTE HOUSE BATLEY YORKSHIRE

New Two Speed-motor....

At the turn of a switch you have two speeds, 33⅓ or 78 r.p.m. The Turntable is a full 12" diameter; its main spindle precision ground and lapped, runs in phosphor bronze bearings. The synchronous motor is virtually vibrationless and is suitable for playing standard, transcription and microgroove recordings. Guaranteed mechanically perfect. New super light-weight pick-up available with the interchangeable heads for microgroove and standard recordings.

Retail price, without pick-up £12-10-0

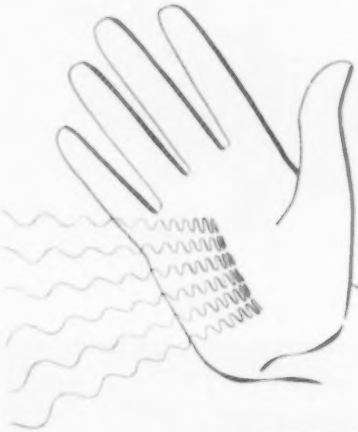
Purchase Tax £5-8-4

A Connoisseur PRODUCT

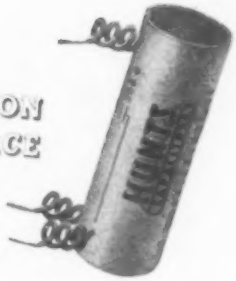
Manufactured by

A. R. SUGDEN & CO. (ENGINEERS) LTD. WELL GREEN LANE BRIGHOUSE YORKS.

For problems of INTERFERENCE SUPPRESSION AT THE SOURCE



As specialists, with unlimited research and development experience in any capacitor application, Hunts can help you considerably with the low-cost production of suppressor equipment to B.S.S. specification and to any reasonable dimension for practically every possible kind of equipment. Designers and manufacturers are invited to let us know their requirements—in strictest confidence.



A typical example of Hunt's suppressor capacitator types. Size: 2"x1" dia. 0.1 + 0.005 - 0.005 250v. A.C. wkg. to B.S.S. 613.

. . . consult the specialists

REGISTERED TRADE MARK
HUNTS CAPACITORS
The Trade Mark of Reliability

A. H. HUNT LTD
Wandsworth,
London, S.W.18
Tel: BATtersea 3131
ESTd. 1901

LONDON OR BIRMINGHAM!

Here is an opportunity worth grasping, build your own Television Receiver at a price you can afford.

- Designed around common types of valves.
- No unusual types to obtain.
- Will suit 9", 10" or 12" Tubes.
- The most competitive price on the market.

CAN BE BUILT FOR £20 (C.R. Tube Extra)

Instruction books PRICE 5/- *post free.*
Write today for further details.

PRE-AMPLIFIERS NOW AVAILABLE

Two stage model, complete with valves, tested	£2 0 0
De-luxe model with built-in power pack, totally enclosed. Ready aligned and tested	£7 10 0

PERM. MAGNET FOCUS RINGS	For Mullard C.R. Tubes. Type FR1	21/-
	For G.E.C. C.R. Tubes. Type FR2	22/6
	For Mazda C.R. Tubes. Type FR3	25/-

HOUGHTON & OSBORNE
Electron Works, Thame, Oxon.
Telephone: Thame 182.

THE "RD JUNIOR" DE LUXE

By popular demand the improved tone control circuit used in our Williamson pre-amplifier has now been incorporated in the "RD Junior" amplifier. This, together with increased N.F.B., low noise audio input stage (Mullard EF40), and other refinements, results in an amplifier which is by far the best available in its price class.

Performance Figures

Frequency response: ± .2 DB 20-20,000 cps.
— 1.3 DB at 30,000 cps.
Distortion: for 8 watts output, not exceeding .5 per cent. total harmonics at 100 and 1,000 cps.
for 10 watts output, 1 per cent. second and third at 100 and 1,000 cps.
Sensitivity: Radio input, 2 v. R.M.S. for 10 watts output.
P.U. input, 170 m/V. R.M.S. for 10 watts output (at 1,000 cps.).
Hum and Noise: With maximum gain, maximum bass boost, and open grid circuit. Gram position—65 DB or better.
Bass and Treble controls: These are of the variable slope type, and give a range of ± 18 DB at 20 and 20,000 cps. Cross-over frequency 1,000 cps.
Pick-up compensation: 6 DB per octave from 250 cps. to 20 cps.
Degree of feed-back: 20 DB.
Due to exceptionally low-phase shift the amplifier is unconditionally stable under all normal conditions.
PRICE: Completely wired and tested in chassis form—£22 10/-.

The amplifier may be heard at our Hampstead premises.
Demonstration times; 10.30 a.m.—12.30 p.m. 1.30 p.m.—5.30 p.m.
DAILY. Thursdays; 10.30 a.m.—12.30 p.m.
Nearest Underground Station—Hampstead—Northern Line.
The amplifier may also be heard at:
The Gramophone Exchange, Shaftesbury Avenue, W.C.2.
Electro-Power Service Co., 390, High Road, Leytonstone, E.11.

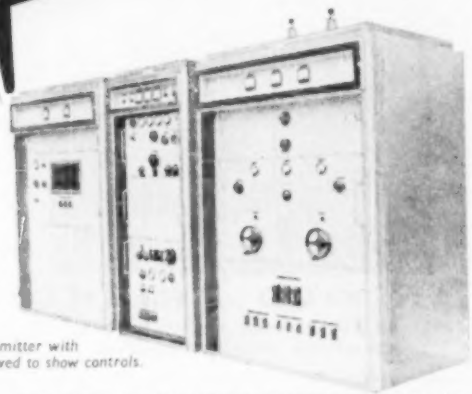
ROGERS DEVELOPMENTS Co.,
106 HEATH STREET, HAMPSTEAD, LONDON, N.W.3
HAMpstead 6901

Serving the Four Corners of the World

The need for reliable Radio communication is being met throughout the world by Redifon equipment for many civil, commercial, marine and aeronautical services. The G.41, illustrated, is a typical example of a 5-7½ KW Transmitter for world wide, high speed Telegraphy, Teleprinter, Telephony and Broadcast purposes.

COMMUNICATIONS

Redifon Radio



G.41 Transmitter with doors removed to show controls.

Radio Communications Division

REDIFON LIMITED, BROOMHILL ROAD, WANDSWORTH, S.W.18

DESIGNERS & MANUFACTURERS OF RADIO COMMUNICATION & INDUSTRIAL ELECTRONIC EQUIPMENT. Phone: VANdyke 5691

A NEW INSTRUMENT FOR THE AUDIO FREQUENCY ENGINEER

For taking the response curves of amplifiers, speakers, transformers, filters and microphones, or measuring the acoustic properties of rooms, studios and radio cabinets, etc., we introduce the :

MODEL 1900 A.F. RESPONSE CURVE TRACER.

FEATURES :

● Entirely electronic in operation. ● Log. frequency scale. ● Frequency range 25 cps. to 20 kcs. in two ranges. ● Accurate frequency calibration based on passive circuit elements. ● Repetition or single stroke frequency sweep. ● Remote single stroke sweep initiation. ● Sweep speed proportional to frequency. ● Approximately constant writing speed. ● Simple recording facilities. ● Built-in stabilised power supply. ● Portability. ● A practical price.

DIRECT CURRENT TO RADIO FREQUENCY

The only oscilloscope combining

- Linear Response from Zero Frequency (DC) to Radio Frequency (0-100 k.c.).
- High Deflection Sensitivity on both axes (70 mV. cm.).
- Complete freedom from amplifier drift under D.C. conditions.
- Absolute independence of controls.
- Perfect synchronising at all Frequencies.
- True portability (weight only 18 lbs.).
- Price **£32.**
- Six months' guarantee.

Model 14008 Visual Alignment Signal Generator shows the shape and characteristics of a tuned circuit response curve on the oscilloscope screen. Perfect alignment of I.F. or R.F. circuits is easily accomplished without an additional signal generator. Price **£8 10s.**

Write for specifications. Early delivery now available.

In preparation : Model 1950 Visual A.F. Wave Analyser.

INDUSTRIAL ELECTRONICS,

99 Gray's Inn Road, London, W.C.1

Telephone : Holborn 9873 4

AN OLD FRIEND

WILL BE RECOGNISED ABOVE BY PRE-WAR "WIRELESS WORLD" READERS.

Luxury "overcoats" to the VOIGT Domestic Reflector Type Corner Horn are, alas, but a memory of pre-war times. After a gap of 7 months, however, our carpenter is able to resume production of the basic horn "in the white." Price **£47 10s.** ex works. See below left.

Your local cabinet maker can veneer this to match your furniture.

Suitable VOIGT P.M. Unit, inclusive of B.B.C. Corrector and the new Rematched diaphragm, is **£60** ex works.

For those with slender purses we are designing a unit with a less powerful magnet and also suggest a simpler type of corner horn, very nearly as good as the above, known as the H.C. Type with bass chamber. Price (in the white), **£19 10s.** ex works.

For further information see "W.W." Sept., 1949, page 33 (Advts.) and "W.W." Feb. 1950, page 66 (Advts.).

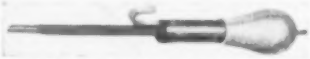
Send your order to

VOIGT PATENTS LTD.
c/o BCM VOIGT
LONDON, W.C.1

P.S.—Delay with correspondence is regretted, but Mr. Voigt has not yet recovered fully.

"ADCOLA" SOLDERING INSTRUMENTS

Reg. Trade Mark



Designed for Wireless Assembly and Maintenance.

Working temperature reached in 1½ mins., consumption 25 watts, weight 2½ ozs.

Supplied in voltage ranges from 6/7v. to 230/250v.

¼" diam. Copper Bit (standard model) **22/6**. ½" diam. Copper Bit **25/-**.

Replacement Unit Bit Elements available.

British and Foreign patents.

Sole Manufacturers

ADCOLA PRODUCTS LIMITED
ALLIANCE HOUSE, CAXTON STREET, LONDON, S.W.1
Write or Phone BRIxton 8075

PLAN YOUR CAREER

RADIO - TELEVISION and other INDUSTRIAL ELECTRONIC subjects

ELEMENTARY & ADVANCED COURSES

DAYTIME

- Principles and Practice of Radio—1 year.
- Telecommunication Engineering—2½ years.
- Electronic Engineering—3 years (*including one year's practical training in E.M.I. Factories*)—leading to C & G full Technological Certificate. (*Next courses begin April 1950*)
- Marine and Air Radio Officers' Course (*for P.M.G. Licence*).

also HOME STUDY

- Basic Radio • Basic Television • Industrial Electronics • Maths. • Physics.

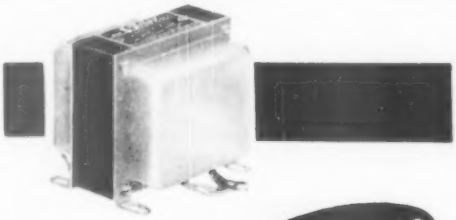
Write for FREE BOOKLET to Dept: 16a

E.M.I. INSTITUTES

10 PEMBRIDGE SQUARE, NOTTING HILL GATE, LONDON, W.2
Telephone: BAYswater 5131/2.

Associated with "H.M.V." MARCONIPHONE COLUMBIA ETC.

E.156a



MAINS TRANSFORMERS & CHOKES

Varley REGD. TRADE MARK

All "Varley" products are manufactured from the highest quality materials.

Transformers, etc., are individually wound and have interleaved windings with ample insulation, ensuring freedom from breakdown.

The comprehensive range of Shielded and Open type Transformers available meets the requirements of every circuit. Write for list, etc.

MADE BY

OLIVER PELL CONTROL LTD
CAMBRIDGE ROW · WOOLWICH · S·E·18
Telephone WOOLWICH 1422

Simon

SOUND SERVICE

NOW AVAILABLE FOR EARLY DELIVERY A REALLY VERSATILE WIRE RECORDER

★ Completely self contained and portable with storage for microphone and leads. Weight 40lbs.

★ Records for one hour at one loading from microphone, radio or feeder unit.

★ Uses large capstan and flywheel to reduce "wow" to a minimum. Rewinds at 6½ times forward speed.

★ Push button controlled for ease of operation.

This up-to-date instrument in its neat carrying case is the ideal "personal" recorder for home or business use. It possesses unlimited applications for use in offices, universities and schools, hospitals and clinics, sales training and advertising departments and for professional artistes and students of drama, elocution and music.

A Wirek Product

FOR DETAILS OF THIS UNIT AND OUR COMPREHENSIVE RANGE OF RECORDING EQUIPMENT AND ACCESSORIES PLEASE WRITE TO :—

SIMON SOUND SERVICE, Recorder House, 48/50, George St., Portman Square, London, W.1.

CABLES: Simsale, London. TELEGRAMS: Simsale, Wesdo, London. TELEPHONE: Welbeck 2371 (4 lines)

MYCALEX

(REGD. TRADE MARK)

THE INSULATOR

May solve your Insulation Problems

with the following

UNIQUE COMBINATION OF PROPERTIES

- HIGH DIELECTRIC STRENGTH
- LOW-LOSS FACTOR
- HEAT RESISTING
- MANUFACTURED TO CLOSE TOLERANCES
- NON-TRACKING
- RESISTANT TO FUNGUS GROWTH
- WILL NOT SHRINK OR WARP
- LOW EXPANSION CO-EFFICIENT

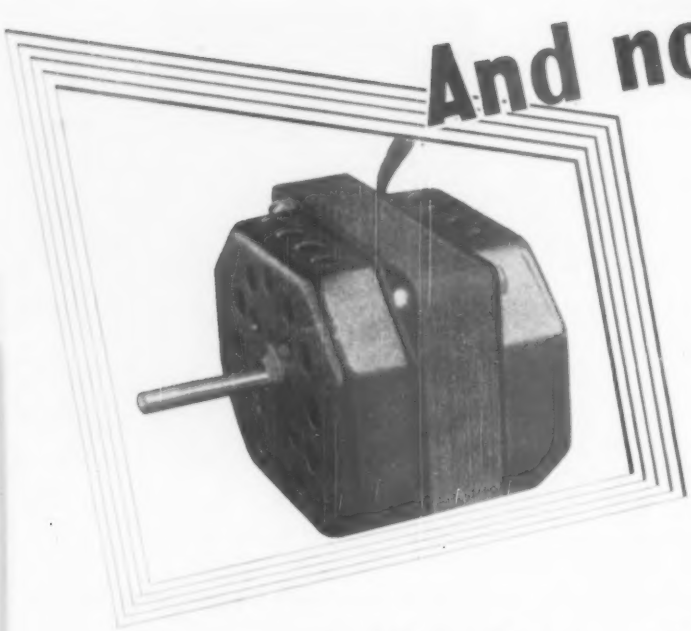
MACHINED TO CUSTOMER'S REQUIREMENTS OR AVAILABLE IN SHEETS, RODS AND MOULDINGS

Also makers of INGRAM MYCALEX Capacitors utilising MYCALEX as a dielectric with plates moulded in, to form a sealed unit

'Phone: CIRENCESTER 400 or send enquiries to

MYCALEX COMPANY LTD ASHCROFT ROAD CIRENCESTER GLOS

And now . . .



Induction Motor FP10

A precision engineered, well balanced 4-pole motor, designed to give constant trouble-free performance indefinitely. The F.P.10 is ideal for record players, tape and wire recorders, timing mechanisms, and every application demanding a constant speed vibration free motor.

Note these attractive features :—

- Fully protected.
- Dual voltage range.
- Negligible external magnetic field.
- Four poles.
- Oil impregnated self aligning bearings.
- Silent running.
- Speed constancy.
- List price 38/-.

Inquiries from manufacturers invited.

PROVISIONAL SPECIFICATION

Voltage, 100/125-200/250.
Frequency : 50 cycles or 60 cycles.
Consumption at 230 v., 14 watts.
Speed, Light : 1,400 r.p.m.
Max. torque : 3in. ounces.
Starting torque : 3in. ounces.
Shaft dia. : .1875in.
Weight : 1¾ lbs.
Size : 3¼in. × 2 7/16in. × 2¼in.
External shaft length : 1 inch.

BSR

Birmingham Sound Reproducers Limited

Telephone : Cradley Heath 6212/3 CLAREMONT WORKS, OLD HILL, STAFFS. Grams : 'ELECTRONIC' Old Hill Cradley Heath

Wireless World

RADIO AND ELECTRONICS

March 1950

39th YEAR OF PUBLICATION

In This Issue

EDITORIAL COMMENT 81
SIMPLE CATHODE-RAY OSCILLOSCOPE. By *M. G. Scroggie* .. 82
TELEVISION SPOT-WOBBLE. By *R. W. Hallows* 84
FRINGE-AREA TELEVISION 87
WIDE RANGE R-C BRIDGE. By *H. E. Styles* 88
INTERFERENCE FROM FLUORESCENT TUBES. By "*Diallist*" 93
DEFLECTOR COIL CHARACTERISTICS. By *W. T. Cocking* .. 95
SHORT-WAVE CONDITIONS. By *T. W. Bennington* 98
WORLD OF WIRELESS 99
EARTH. By "*Cathode Ray*" 103
SOLVING PARALLEL PROBLEMS. By *D. A. Pollock* 107
ELECTRONIC CIRCUITRY. By *J. McG. Sowerby* 108
NEGATIVE FEEDBACK. By *E. Griffiths* 111
UNBIASED. By "*Free Grid*" 114
LETTERS TO THE EDITOR 115
RANDOM RADIATIONS. By "*Diallist*" 118
MANUFACTURERS' PRODUCTS 120

Managing Editor: HUGH S. POCOCK M.I.E.E.

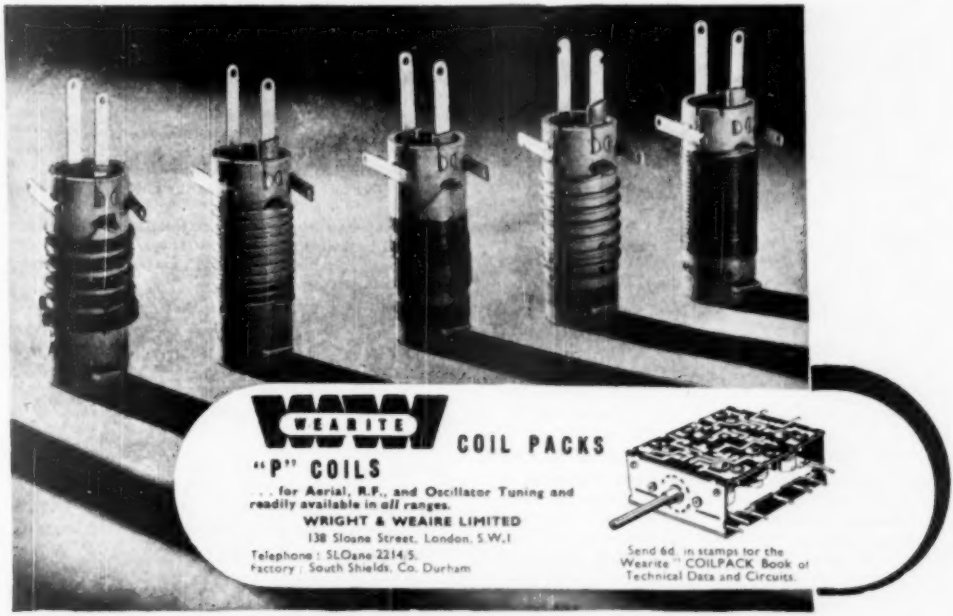
Editor: H. F. SMITH

PUBLISHED MONTHLY. Price 2/- (last Thursday of preceding month) by ILIFFE & SONS LTD., Dorset House, Stamford St., London, S.E.1. *Telephone*: Waterloo 3333 (60 lines). *Telegrams*: "Ethaworld, Sedist, London."

ANNUAL SUBSCRIPTION:
Home and Overseas, £1 6s. 0d.; U.S.A. and Canada, $4.50

BRANCH OFFICES:

Birmingham: King Edward House, New Street, 2
Coventry: 8-10, Corporation Street,
Glasgow: 26B, Renfield Street, C.2.
Manchester 260, Deansgate, 3



Valves and their applications

AN ELECTRONIC TIMER FOR LONG TIME DELAYS USING EF91

In industrial processes and in domestic equipment there is often a need for a device which will automatically operate a switch after a predetermined time interval of several minutes. Various applications will be apparent to readers. As an example, it may be used in conjunction with an electric toaster to switch off the current before the toast is burnt. An improved timing circuit using only one valve and operating directly from the A.C. mains is described below.

Time-delay circuits employing valves generally belong to one of two groups. In the first of these a simple resistance-capacitance circuit holds off the valve during the timed interval, while in the second the Miller effect is used to retard the rise of anode current in a valve-operated relay circuit.

Circuits of the first group are generally suitable for time delays up to about ½ minute, since for longer periods the values of capacitance and resistance required become unduly large for most practical applications. On the other hand circuits of the second group can be used for time delays of as much as fifteen minutes without unduly large resistors and capacitors.

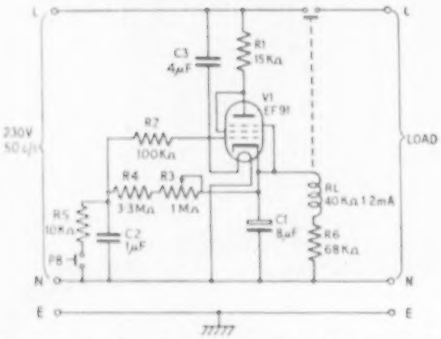


FIG. 1 CIRCUIT OF ELECTRONIC TIMER

A simple time-delay circuit using the Miller feed-back principle is shown in Fig. 1. The valve V_1 functions as a half-wave rectifier to charge the electrolytic capacitor C_1. The rise of potential across C_1 is retarded by the feed-back capacitor C_2 which is initially uncharged. As the potential across C_1 tends to rise, C_2 charges through R_3 and R_4, pulling the grid of V_1 negative and thereby retarding the rate of rise of potential across C_1. The effective retardation is dependent primarily on the values of R_3, R_4 and C_2, and is nearly independent of C_1, provided that C_1 is large.

The variable resistor R_3 provides an adjustment of the time delay. With the component values given, the delay is 1½ to 2 minutes. Much longer delays than this can be obtained by using larger values of C_2 and R_4.

The relay RL is a high-resistance telephone relay with a low operating current, and is connected in series with a resistor R_6 across the capacitor C_1. The value of R_6 is such that the relay RL closes when the voltage across C_1 has risen to about 90% of its final value. When the circuit is switched on, the first delay period includes the warming-up time of the valve V_1. The circuit is reset after each operation by means of the push button PB which is arranged to discharge the capacitor C_2.

The heater current for the EF91 is drawn directly from the A.C. supply through the capacitor C_3 which is chosen to give 0.3A. With this arrangement one end of the heater must be connected to the neutral line of the A.C. supply. The voltage across capacitor C_3 is therefore applied between the heater and cathode of the valve and must not be allowed to rise above the permissible heater-to-cathode voltage of the EF91, namely 150V. Resistance R_7 is included in the anode circuit to limit this voltage to a safe value.

The component values in Fig. 1 are typical but some modifications will be necessary for different relays and time delays. Capacitor C_1 is electrolytic, C_2 and C_3 are paper. All resistors are ½W rating.

Mullard

Reprints of this report from the Mullard Laboratories may be obtained free of charge from the address below.

MULLARD ELECTRONIC PRODUCTS LTD.
TECHNICAL PUBLICATIONS DEPARTMENT,
CENTURY HOUSE, SHAFTESBURY AVE., W.C.2

M-M121

Wireless World

VOL. LVI. No. 3. MARCH, 1950

Auxiliaries to Television

THE setting-up of a national television service is not just a matter of deciding upon the best standards of transmission, of erecting suitably sited stations and then making available to would-be viewers a supply of receivers at prices they can afford. True, these things are of basic importance, and, as we have said in recent issues, *Wireless World* considers the foundations of a nation-wide service have been well and truly laid. But, however sound the foundations, a service cannot grow unless programmes are attractive and attainable at an economic cost. These matters are not our direct concern, but it is vitally important to us that the technical details of programme distribution should be developed to a high state of excellence. Economy in programme costs is as important as quality; television material is costly, and, at the present stage of development, the cost cannot be spread over a vast number of subscribers. It is reassuring that the B.B.C. is ready with equipment for serving the wider—and, presumably, increasingly more exacting—public for which it will soon have to cater.

Of these technical auxiliaries to the distribution of programmes, probably the most important are those for recording and subsequent retransmission on film. If we can go by the analogy of sound broadcasting, television will depend increasingly on the vision equivalent of sound recording, whereby films of current events can be made for use when required. The new "telefilm" recorders, described briefly in our January issue, fulfil this purpose. With the help of the ingenious and effective trick described as "spot wobble" (see page 84, this issue) the lines of the picture are made to disappear, and surprisingly little degradation of quality results from the combined processes of photographing from the end of a tube, subsequent scanning and then retransmitting the picture. New scanners also being installed will facilitate the handling of film, while elaborate apparatus has been installed for "dubbing" and other processes involved in preparing films

The "telefilm" apparatus just mentioned is, of course, for recording events picked up by the television camera. Ordinary sound-on-film news-reels, photographed direct from the scene, also have their place in programmes, but the normal speed of processing is often too slow for television, and so the B.B.C. is developing a method of recording on magnetic film the sound which accompanies the picture. This, it is claimed, will substantially reduce production time, and should help television to retain its outstanding advantage of speed in presenting "actualities." At the same time, sound quality should be improved.

Aerial Restrictions

MANY local authorities have banned the erection of television aerials on houses under their control, or else have imposed distinctly onerous restrictions. It would seem that in many cases this attitude has been due to ignorance, and we congratulate the Radio and Electronic Component Manufacturers' Federation on taking active steps to dispel ideas which would certainly be prejudicial to the rights and privileges of tenants.

The Federation has set up a panel of experts who are willing to advise housing and municipal organizations or any others concerned with the problems of television aerials. The panel will make recommendations for aerial installations which would provide adequate reception without unnecessary interference with the architectural appearance of the buildings concerned. Apart from æsthetic considerations, no doubt the panel will be able to give useful information as to the risk—or lack of risk—of damage to the building due to the fitting of a properly installed television aerial. It is good to hear that some councils who have been strongly opposed to television aerials have shown a much more tolerant attitude after discussions with the panel.

Simple Cathode-Ray Oscilloscope

Design for an Inexpensive Instrument "Without Frills"

By M. G. SCROGGIE, B.Sc., M.I.E.E.

OSCILLOSCOPE designs that have appeared in the technical press since the war have tended towards more and still more facilities and refinements, which of course is all very well in its way but rather discouraging to the amateur with modest means and requirements. So it seems that there may be room for details of a design which covers most ordinary needs simply and inexpensively.

Like most oscilloscopes, it comprises three departments:

(1) The cathode-ray tube itself, with its voltage supplies and controls for focusing, brightness, and shifts.

(2) A variable-frequency time-base generator, with synchronizing device.

(3) A deflection amplifier.

It is in (2) and (3) that there has been such lush growth in recent years. Demands for extreme linearity and such facilities as triggered "single-shot" and time-calibrated sweeps have resulted in elaborate multi-valve time-base circuits; and a wide-frequency-range amplifier must have low-resistance couplings, hence many stages—especially if push-pull is called for.

In the present design all the usual facilities as regards (1) are included. A single-valve amplifier gives a controllable gain of up to about 41 db (or ×110) at audio frequencies, and 26 db (or ×20) over a wider band. The tube can of course be used without amplification over a wide range of v.f. and r.f. The time base works at frequencies between 12 c/s and 40,000 c/s, so can be used for waveforms at least up to 500 kc/s. It departs perceptibly from perfect linearity, but if this is considered objectionable it could be overcome with the help of a sweep amplifier, similar to the above.

Principal Components

The tube specified is the VCR.138 because it is readily available at a very low price, it focuses excellently at low voltages, and has a nearly flat 3½in screen. The power supply consists of any ordinary 350-0-350V receiver transformer and two small Westinghouse rectifiers. Time base and amplifier each need a single valve. The rest consists entirely of resistors (fixed and variable) and capacitors, with three switches, a few terminals, and some sort of container.

Power Supply. The required transformer outputs are:

(*a*) 4 V, 1A for the c.r. tube heater, (*b*) 6.3V, 1.5A for the amplifier and time-base valve heaters, and (*c*) 700V for h.t. supplies (not more than 8 mA d.c.). An ordinary receiver transformer gives more than enough for all these, and, unless one wants to keep weight down to a minimum, will do in place of a special transformer. At such a reduced load it will give rather more than 700V r.m.s. between the end connections of the h.t. secondary, but the Westinghouse 16HT56 is rated up to 840. Assuming an actual 750V under load, the output across the reservoir capacitor is about + 850V. The maximum rated d.c. output for this rectifier (half-wave) is 8 mA, and the actual current lies between 5 and 6 mA.

The 36EHT25 rectifier supplies about − 950V 0.5 mA, of which about 900V is available as anode voltage for the c.r.t. If the transformer voltage is liable to exceed 740V it would be prudent to use the next larger rectifier, 36EHT30.

The winding used to supply the c.r.t. heater current should of course be sufficiently well insulated to stand 1000V peak to the earthed end of the h.t. secondary and 2000V to the other end.

Except that the reservoir capacitance (C_{20}) for the 16HT56 rectifier is rated at 1μF maximum, there is no objection to using larger smoothing capacitances than those specified.

C.R.T. Circuits. The VCR.138 tube (Mullard equivalent ECR.35) is rated at 1200V anode voltage (2500V max.). It gives good focusing and brightness at 750V, but is definitely poor at 500V. In the present design it receives about 900V, at which the peak-to-peak voltage required for 50 mm deflection is approximately 125V between the X plates and 60V (= 21V r.m.s.) between Y plates. Therefore as little as 1V r.m.s. gives 2.5 mm Y-deflection.

The arrangements for controlling focus, brightness and X and Y shifts are entirely conventional. The wiring should be kept away from the 50 c/s h.t. connections, and a Mumetal screen for the tube is almost essential for preventing stray 50 c/s deflection.

Time-Base Generator. A gas-filled triode is used in the usual manner to discharge a selected capacitor at a frequency depending on the rate of charge and also on the grid bias. The following table will be a guide to the approximate frequency ranges obtained with the circuit shown, assuming the length of the time-base on the tube is adjusted to 50 mm:

As usual, the "length" and "frequency" controls are interdependent, but variations in length when the frequency control R_{23} is adjusted are

Capacitance, μF	Frequency, c/s
0.3	12–53
0.1	35–160
0.03	120–530
0.01	350–1,600
0.003	1,200–5,000
0.001	3,600–14,000
0.0003	13,000–40,000

minimized by means of R_{24} which passes a compensating current through R_{25} (controlling the bias) when the current via R_{22} is reduced. The base length is less at the middle of the R_{23} frequency range than at the ends, but not seriously so.

When the time base is set to a normal working length—50 mm—the capacitor across V_2 charges to only about one-sixth of the available h.t., so it is linear enough for most purposes. The alternative would be either to use a series pentode (on the negative side of the EN31) in place of R_{23}, or—more conveniently—to restrict the amplitude still more by reducing R_{23}, and then amplify it. An amplifier similar to the Y-deflection amplifier would be suitable, and the rectifier would just stand the extra drain.

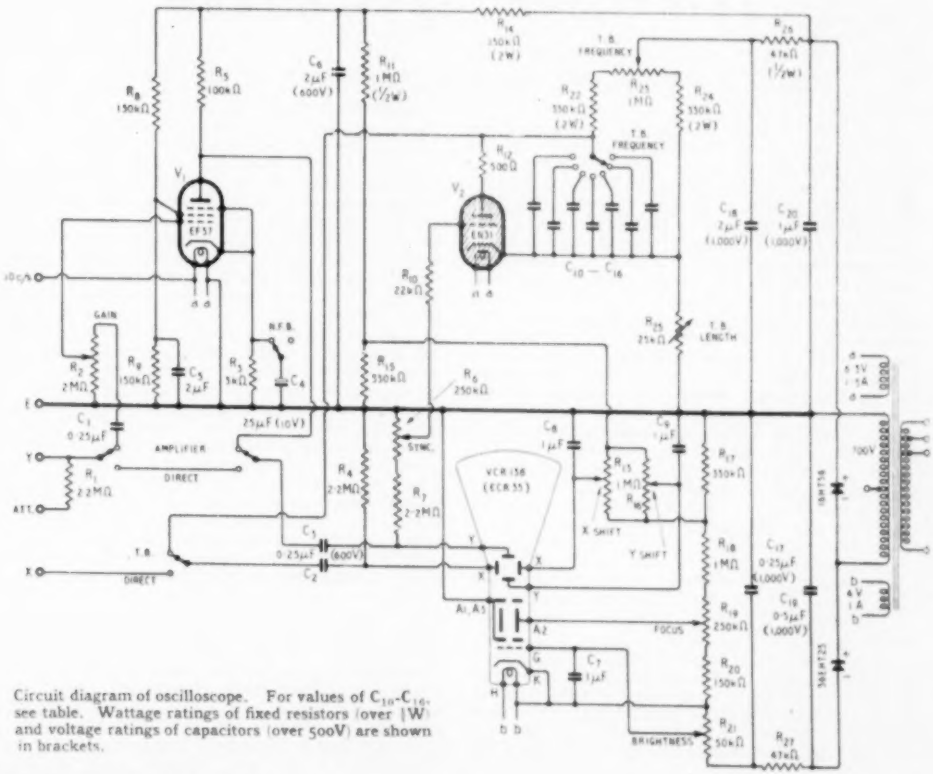
The synchronizing control, R_6, enables anything up to about 10 per cent of the Y-plate "work" voltage to be applied to the grid of V_2. This control performs very well; a fraction of its maximum is generally sufficient to lock the trace firmly to a signal of reasonably constant frequency.

Amplifier. By not attempting to extend the frequency range much above audio frequencies, one easily obtains a voltage amplification of 110–120 from a single stage. And since the peak-to-peak output voltage need seldom exceed 60V out of an available 500V h.t., there is very little distortion. That is with the bypass capacitor C_4 in circuit. When it is switched out, negative feedback reduces the gain to about 20, which affords a convenient step-adjustment of gain, and incidentally improves the uniformity of amplification. Over 20–20,000 c/s it is almost perfectly level, and a useful gain remains at some hundreds of kc/s, for v.f. tests, etc.

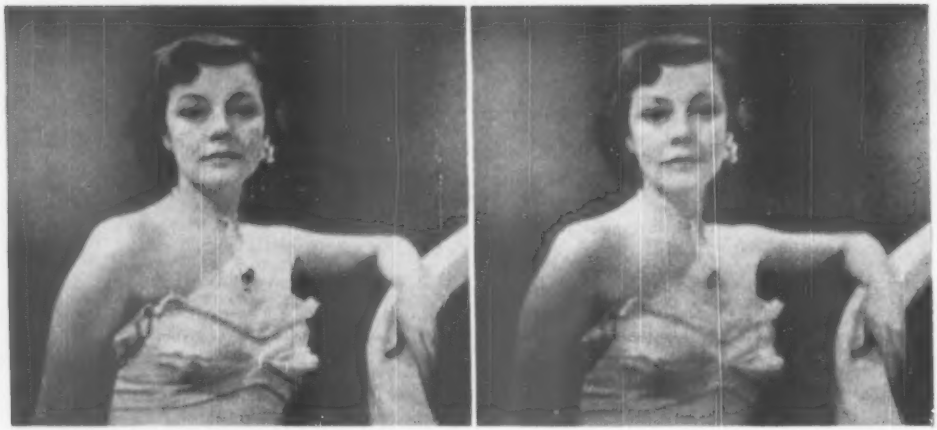
If the gain control R_2 is set low, its attenuation at high frequencies may be less than expected, due to bypassing by stray capacitance. A resistance R_1, which can be extended if desired, is included to bring voltages over 100 inside the "picture." The method of switching the amplifier is more convenient than separate terminals for Y-input, "with A" and "without A," but stray switch capacitance, should be minimized by careful wiring.

General. No particulars of container and layout are given, because they can be arranged to suit convenience and requirements. Owing to the high resistance of the circuits associated with the c.r.t., the main thing in laying out and wiring the job is to avoid capacitance coupling from points of high alternating potential, especially the live end of the transformer h.t. winding. Reasonable care over this is rewarded by steady sharply-defined traces.

A useful feature is a terminal connection to the live end of the 6.3V winding, which gives 18V peak-to-peak 50 c/s for setting-up, frequency calibration, and many other purposes.



Circuit diagram of oscilloscope. For values of C_{10}-C_{16} see table. Wattage ratings of fixed resistors (over 1W) and voltage ratings of capacitors (over 500V) are shown in brackets.



Elimination of lines by spot wobble is shown on the right : photographs taken with the new B.B.C. "telefilm" camera

Television Spot-Wobble

Simple Technique for Combating "Lininess" in the Raster

By R. W. HALLOWS, M.A. (Cantab), M.I.E.E.

EVERY viewer is familiar with the unpleasing effect known as "lininess" in the images on the screen of a television receiver. The proverb tells us that we can't eat our cake and have it: television reception, on the other hand, appears to show that if we use a technique which involves cutting the image into horizontal slices, we are bound to find that we have "had it" in the unpleasant impression produced by the dark lines which cross the screen from side to side. Experts hasten to assure us that if the lines are obvious enough to annoy us, we are sitting too close to the viewing screen. "Move away," they urge, "until the lines of which you complain are no longer sufficiently clear to call your attention to them; you then won't be conscious of them at all, and you will see the television image as it should be seen."

Although I have a respect amounting almost to veneration for the pundits of radio and television, no very deep processes of thought or observation are required to bring one to the conclusion that the offensive dark horizontal lines are part and parcel of the fine detail of the image shown on the television screen. Remove yourself far enough to lose the lines and don't you automatically lose also something of the sharpness of the picture? My vision is, admittedly, not normal now; I have not only to use glasses, but also to wear different glasses for distant work and for reading. For that reason I should hesitate to base any criticism of a television reception system on the evidence of my own eyes alone. I find, though, that those with normal vision with whom I discuss the subject hold opinions very like my own: moving far enough from the television screen to make the lines unnoticeable means, willy nilly, the acceptance of a not very sharp or detailed picture. Certainly there was no discrepancy in the views expressed by the owners of good, moderate and not-so-good eyes at a recent demonstration of spot-wobble television reception. All of us agreed that it was a joy to be able to sit near enough to the screen to see all the detail, and yet not to be worried by lininess in the image.

Having heard something of spot-wobble, and finding that it was in regular use in the B.B.C. Research Department, I asked whether one or two friends and myself might be allowed to sample its achievements. I have to thank Mr. S. N. Watson, of the B.B.C. Designs Department, for his ready co-operation and help. Spot-wobble (which, as its name suggests, means that the receiver scanning spot takes a wobbly, instead of a straight, course across the screen) can hardly be described as new, for the original patent was taken out in 1934 by a French company engaged in the manufacture of gas meters! Until fairly recently, though, it does not appear to have been exploited; and so far as I know, no use of it has yet been made in any domestic television receiver.

The instrument used for the demonstration was a receiver, very much of the *de luxe* order, specially made for the B.B.C. by Cinema-Television, Ltd., and containing a 20in c.r.t. I imagine that its cost

would be in the neighbourhood of nine or ten times that of the ordinary domestic set—the tube alone runs, I believe, to something like £80! Apart from the size of the screen, striking features of this set are the sharpness of its focus and the perfection of the interlacing, clearly seen in its raster.

The first surprise was furnished by the position of the chairs in which we were asked to take our places. I did not actually measure the distance between them and the screen, but I am sure that it was not more than seven or eight feet. The reader will know that this is very much less than the optimum viewing distance laid down by the experts for the $17\frac{1}{2} \times 14$in picture shown. The lines should have been very much in evidence; and when the picture first appeared they were.

I was handed a small box connected by a length of twin flex to the receiver. "Cut the spot-wobble in or out as you like," I was told. "It's out now; but do that with the switch and it's in." I promptly did "that." The lines disappeared as completely as if some wizard had removed them with a magic duster. Handing the box to another of the party I put on my reading glasses, which focus at about 14in, and went close up to the screen. Looking right into it in this way one could still see no lines. One was conscious of what I may term a kind of small-scale turbulence of the picture elements, which was somewhat reminiscent of Brownian Movements. This activity is entirely invisible at over about 3ft to people with ordinary sight. The picture appears clear, detailed and with no dark lines.

Effect of Focusing

Thinking over the demonstration later on, I was led to wonder whether the full effectiveness of spot-wobble had not been due largely to the combination of a big screen and focusing arrangements so good that the spot was far smaller than that of the overall domestic television receiver. These points I mentioned to a friend who was going to see the apparatus later. A small screen-set was not available, but at his suggestion, definition was degraded by de-focusing until it was judged to be of average "domestic" quality. The improvement affected by spot-wobble was still definite and pleasing.

So much for the results of spot-wobble. The reader will now want to know just what it is and how it is done. In the familiar system of scanning the screen of the receiver c.r.t. the spot takes a straight-line course from left to right across the screen as it stipples in the image by its varying degrees of brightness from instant to instant. We speak of the television image as made up of blacks, whites and greys. Actually, there are probably few absolute whites or absolute blacks, the image being built up of an infinite variety of greys, ranging from extremely pale to extremely dark.

If we knew how to produce either a square-shaped scanning spot or a perfectly circular spot of unvarying diameter, no dark lines would appear on the screen to annoy us, for the diameter of the spot could be made always equal to the width of a line. Actually, the spot is only roughly circular in shape and its apparent diameter varies in practice quite considerably with the degree of brightness. On whites the spot has a very bright central portion, though its brilliance tails off towards the sides; it then appears to be larger than when it is dealing with medium, dark and very dark greys. The net result of all this is that the average diameter of a properly focused spot is a little less than the width of the slice of the image that it is painting in. At the top and bottom of the scanned line there are two narrow unactivated strips of the screen and, unless one views it at not less than a certain minimum distance, depending on its size, the image shows dark horizontal lines.

The better the focusing arrangements of a television receiver the smaller is the spot. This has two results. The first is improved definition; for the smallest element of an image that the spot can reproduce properly is one that is at least as large as itself. This is brought out in Fig. 1, from which it is seen that the brilliance of the spot at any instant corresponds to the *average* shade of the tiny portion of the image with which it is then dealing. As the figure shows, a spot large enough to fill the scanning line completely cannot reproduce the finest details of an image; an area consisting of tiny black and white elements is painted in as a grey patch. In many domestic receivers the focus is not very sharp, and there is consequently some loss of detail.

The second result of sharp focusing is to make the spot so small that, though it can cope with the finer details of the image, its diameter is less than that of the scanned strip. Hence, marked horizontal lines are produced on the screen, and to get rid of their effects the viewer must be so far away that he loses, perforce, much of the improved definition.

In other words, lininess is not so obvious as to be particularly offensive in the television receiver whose focus is not very sharp; but it becomes more and more marked as the focusing arrangements—and the definition—are improved in better designed instruments at higher prices. Third, although spot-wobble is of the utmost value when applied to high-quality receivers, it is not to be expected that it will produce an equally striking improvement in sets in which the spot-focus is not very sharp. Nevertheless a definite improvement is likely even in these.

The spot-wobble system is so utterly simple that one cannot refrain from wondering why it was not thought of and applied at the very inception of c.r.t. television. But it is the way of important inventions to be completely simple—and of people to kick themselves for not having thought of them.

What will happen if a small, rapid, up-and-down movement is superimposed on the lateral travel of the spot? Make the movements in the vertical sense sufficiently rapid and the amplitude of those movements so small as not to overlap seriously the

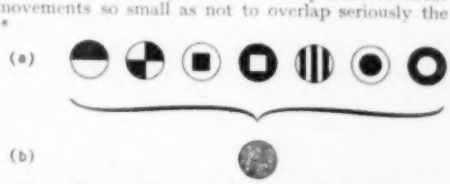


Fig 1. The scanning spot cannot deal adequately with any element of an image with an area less than its own. The spot, in fact, records on the screen elements representing the average illumination of areas of the same diameter as itself. Hence, the fine detail of each of the seven tiny areas seen at (a) is lost, and all of them appear on the screen as the small uniform medium-grey patch (b), the shade of which corresponds to the average brightness of each. The smaller the spot, due to good focusing, the better is detail brought out.

boundaries of one scanning line, then the wobbling spot will activate virtually the whole rectangular area of the screen corresponding to the line. To put it in another way, there will be what amounts to vertical elongation of the spot, and this, if correctly regulated, will annul the failure of the sharply focused spot to cover the full width of the scanned strips which, in the ordinary way, provides each line with dark borders and gives rise to lininess. The scanning element becomes a short vertical line instead of a spot and the gaps are filled without losing horizontal definition.

Additions to the Receiver

That, precisely, is what is done in spot-wobble. The effects are illustrated diagrammatically in Fig. 2. By using spot-wobble we scan, in effect, not with a roughly circular spot, but with an elongated spot. The essence of the spot-wobble system is to give the spot a vertical movement at a frequency approaching 1,000 ups and downs—let us call them cycles—per line. For our British 405-line, 25-image-per-second system this means a frequency of the order of 10 Mc/s. It would clearly not be feasible to apply this at the transmitter, the total modulation bandwidth of which is some 2.8 Mc/s. But there is no need for this. Spot-wobble is, in fact, essentially concerned with the receiver; and it is so simply produced that the additional cost need hardly exceed £1.

It might be done electrostatically by the use of two small deflector plates; but I was given to understand that magnetic methods are used in the instrument which we saw. The necessary additional circuits are shown in Fig. 3. They are given in block form partly because they are so simple and partly because the optimum component values for any particular television receiver must be found by experiment. The on-off switch is required because the receiver should be focused as sharply as possible with the wobbler out of circuit. That having been done, the switch is closed. To start with the control knob should be at the position giving minimum amplitude. Then the amplitude is gradually increased until the best balance is reached between welcome loss of lines and unwelcome loss of definition.

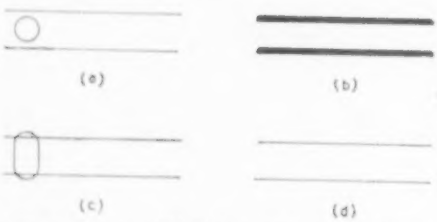
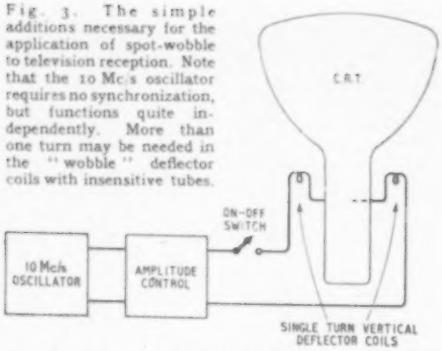


Fig. 2. The unwobbled "round" spot does not (a) quite fill the strip of the image which it scans. The result (b) is that each strip has narrow black borders and that the image is "liny." The better the focus, the smaller the spot and the better the definition—but the more pronounced also is the lininess. The wobbled spot (c) provides much the same effect as would the actual elongation of an unwobbled round spot. The scan slightly overlaps the edges of the strip and there are no unactivated portions of the screen; hence (d) the scanned strip is reproduced without the black borders, and the lininess disappears.

Fig. 3. The simple additions necessary for the application of spot-wobble to television reception. Note that the 10 Mc/s oscillator requires no synchronization, but functions quite independently. More than one turn may be needed in the "wobble" deflector coils with insensitive tubes.



For it must be admitted that spot-wobble results in a slight loss of vertical definition. When the proper adjustment of the amplitude is made the loss is very small indeed, and, as the vertical definition is rather better than the horizontal with existing systems, this is a matter of no real moment.

It is interesting to calculate the effects of a 10-Mc/s superimposed wobble on 405-line, 25-image-per-second reception. These can conveniently be based on a 10 × 8-inch image, for that is fast becoming the most popular size. Working in round figures, this frequency gives 1,000 wobbles per line. But the visible portion of the line is only 83.5 per cent of the whole; hence we have 835 up-and-down movements of the spot in 10 inches, or 83.5 in each inch of scanned line on the screen. The "wavelength" of the wobble in a 10 × 8-inch picture is thus 1/83.5 = 0.012in.

Since 377 "active" lines compose the screen image measuring 8in from top to bottom, the width of one line is 8/377, or 0.021in. As we have seen, the average diameter of the unwobbled spot is a little less than the width of one line. Let us call it 0.02in for the sake of argument. It will be seen that cutting in the spot-wobble circuit causes the scanning spot to describe very nearly two complete up-and-down movements as it travels a lateral distance equal to its own diameter.

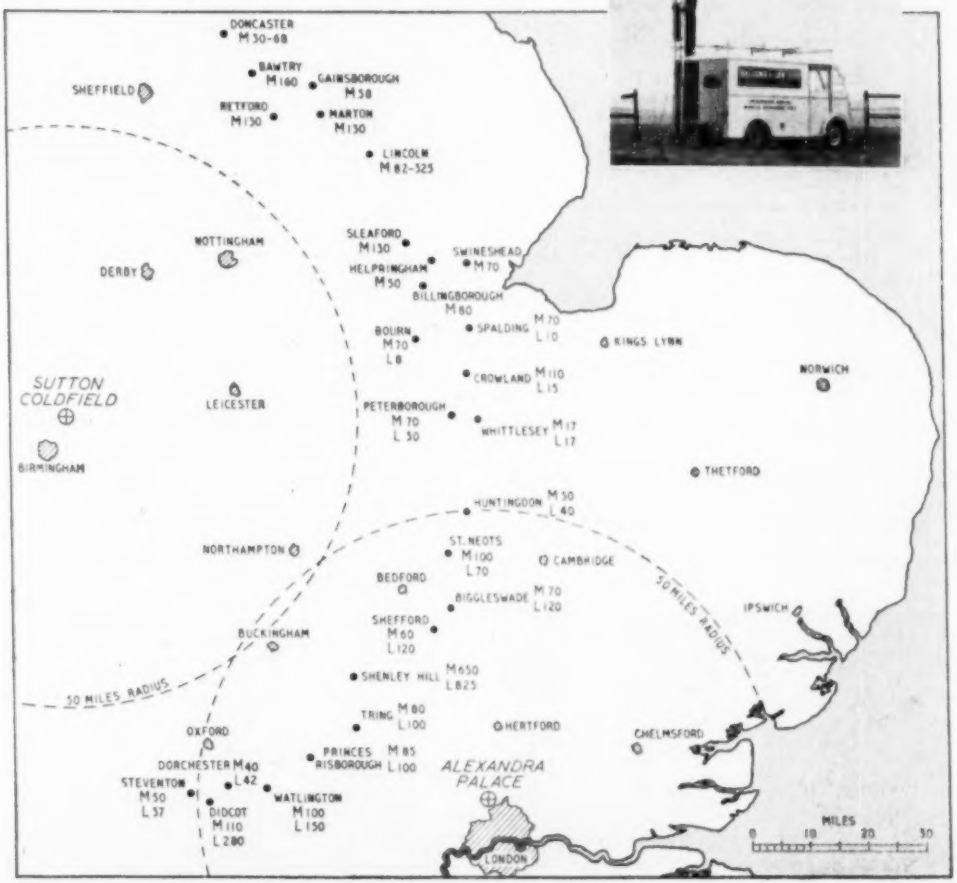
It is open to question whether spot-wobble would work equally well with sequential scanning. Quite possibly the amplitude of the wobble, when adjusted to give the best results with interlaced scanning, would result in an undesirable overlap on "peak whites" (when the spot has its maximum diameter) in a sequential system. A smaller amplitude might be ineffective. But we do not seem likely to be concerned, at any rate in the near future, with any but interlaced systems; and with these, spot-wobble appears to supply the best means yet devised of making the even-numbered scanning lines adequately fill the gaps between those of odd number. It is interesting to speculate on the possible applications of spot-wobble to existing and future schemes for both colour television and stereoscopic television. Any system which permits a controlling frequency of 10 Mc/s or more to be applied to the scanning spot, quite independently of the transmitter bandwidth, or of the pass-band of the receiver's r.f. and i.f. circuits, is clearly worthy of serious attention by those now engaged in the research which will lead to the television of tomorrow.

Fringe-Area Television

Map showing Midlands Station Field Strengths Outside the Recognized Service Area.

THIS map has been compiled from data gathered by Belling and Lee during the first part of a tour by a mobile field-strength measuring van (shown inset) on a radius of roughly 70 miles from Sutton Coldfield. Height of the 4-element receiving aerial array used for the measurements was 40ft above ground level. Vision signal strengths are shown in microvolts per metre for the Midlands station (M) and, where receivable, for London (L). At a few sites wide variations were met: these are indicated by minimum and maximum figures. At most sites a good picture was obtainable in the van from a representative commercial monitoring receiver fitted with a single-stage pre-amplifier when signal strength was 70 μV/m or over.

(Data published by courtesy of Belling and Lee.)



Wide Range R-C Bridge

A Simple Instrument for Resistance, Capacitance and Insulation Measurements

By H. E. STYLES, B.Sc.

IN these days of readily obtainable surplus radio components it is more than ever necessary to have a means of checking resistors and capacitors since these often bear no readily identifiable markings and may in any case be defective.

The use of an a.c. bridge for the measurement of resistance and capacitance will no doubt be familiar to most readers of this journal, as also will be the use of a neon "flasher" for insulation testing. The instrument to be described has been designed with a view to performing these three tests with a minimum of equipment. It has, moreover, a more open scale than many bridges, and can be operated from either a dry battery or a very simple mains unit, since its power consumption amounts only to about 0.1 mA at 200 V.

Bridge Circuits. The simplest a.c. bridge comprises the circuit of Fig. 1. In this an alternating potential is maintained across a potentiometer P, and an unknown resistance X is compared with a known resistance S by adjusting P until no sound is audible in the telephone receiver T. Under these conditions $X = \frac{B}{A}S$, where B and A are the resistance values of the two portions of the potentiometer at the balance point. Whatever the value of S, a given setting of the potentiometer always corresponds to a particular ratio between S and X and therefore a scale can be fitted to P to indicate this. It is evident that such a scale will extend from infinity at one extreme to zero at the other, the centre point corresponding to a ratio of unity. It follows that for ratios greater than unity the graduations must rapidly become very compressed.

The circuit can also be employed for comparison of capacitances, but if the same ratio scale is to be used it is necessary to interchange the position of the unknown and known components, since the bridge actually compares reactances which are, of course, inversely proportional to the capacitances.

Fig. 1. Simple bridge circuit.

Fig. 2. Improved bridge circuit.

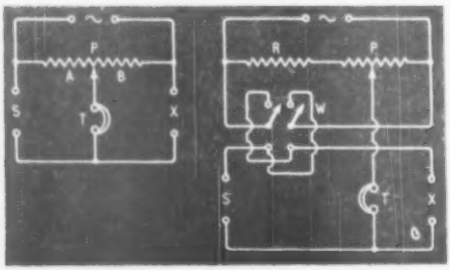
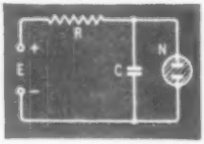


Fig. 3. Neon oscillator.



An improved circuit is shown in Fig. 2. In this a fixed resistance R is placed in series with the potentiometer P which must have a resistance slightly greater than R. A change-over switch W provides a means of interchanging S and X so that the bridge can always be balanced, regardless of whether S or X has the greater resistance. A ratio of unity, however, now corresponds to a potentiometer setting close to the extreme limit adjacent to R, and rotation of the potentiometer away from this position corresponds either to an increase or a decrease in ratio according to the position of switch W. Thus an almost complete rotation of the potentiometer now corresponds either to a range of ratios of from unity to zero or from unity to infinity so that the effective scale length is twice that of the circuit of Fig. 1. The potentiometer has to be provided with two scales, but this presents no difficulty since one is merely the reciprocal of the other. Which scale has to be used during any particular test is determined by the position of switch W, and, when testing capacitors, it is merely necessary to employ the scale opposite to that which would be used were resistances being compared.

A.C. Excitation. Various types of a.c. generators may be used for bridge excitation but, as will be seen later, the complexity of the test equipment and its versatility are considerably affected by the type of generator selected. Amongst possible sources of a.c. the following are commonly employed:—

1. *Electro-magnetic buzzers.* These are normally suitable for battery operation only, are somewhat difficult to maintain and required to be sound-proofed to obviate acoustic interference. Their frequency range is restricted and additional equipment must be provided for insulation testing.

2. *50 c/s a.c. mains.* This is far from an ideal source since neither the ear nor most telephone receivers are very responsive to a frequency of 50 c/s, whilst such a low frequency results in unduly high values of reactance when dealing with small capacitances. Hum pick-up from stray leakages may mask the null position, the frequency is fixed, and, obviously, such a source can only be used if a.c. mains are available. Added equipment is necessary for insulation tests.

3. *Valve oscillators.* These can be made to produce any desired frequency and can be mains or battery driven. Power consumption, however, may be relatively high owing to the necessity for cathode

heating and, in the case of mains-driven units, a fair amount of ancillary equipment is required. Additional equipment is required for insulation testing.

4. *The neon oscillator.* In the author's opinion this is the almost ideal a.c. source for simple bridge work. Very few components are needed and the oscillator can be operated from either batteries or mains (d.c. or a.c.). Power consumption is negligible, the frequency can be adjusted over a wide range, and, finally, the same components can be used for insulation testing. An extremely compact unit can be constructed if miniature neon tubes such as are employed in certain types of tuning indicators are used, but even with more normal tubes a compact assembly is possible since, in essence, the oscillator comprises only the three components shown in Fig. 3.

A "d.c." potential E charges the capacitor C through a high resistance R until the potential of C reaches the striking voltage of the neon tube N. At this stage capacitor C becomes partially discharged until its potential falls to the extinction voltage of N, when the cycle repeats itself. By suitable choice of values for E, R and C the repetition frequency can be varied from a few cycles per second to above the limit of audibility. With two of the values fixed, variation of the third gives a wide though not full range of control and applied voltage is a convenient choice of variable.

Insulation Testing. The circuit of Fig. 3 can be applied without alteration to the testing of the insulation of components such as capacitors, since, provided the combined leakage resistance of the neon tube, its holder and the shunt capacitor is sufficiently high, the capacitor can still be charged up to the striking voltage of the neon tube even though an extremely high resistance be inserted in series with the tube and the source of fixed potential. The striking frequency will, of course, decrease as the series resistance is increased, but with careful attention to the insulation of the oscillator it is easily possible to make it responsive to leakage resistances of 100 megohms or more. Owing to the small value of shunt capacitance required to produce a suitable frequency for bridge operation, the flashing of the neon tube is not so brilliant as is usual for "flash" testers, but this is no disadvantage since the occurrence of flashing is accompanied by the production of an audible signal in the telephone. In fact, in the author's instrument the neon tube is mounted behind the panel and its flashing is in any case not visible.

The objection might have been raised that a neon oscillator necessitates the use of somewhat high operating potentials, but this can now be seen to be invalid since if insulation tests are to be made it is obviously desirable to conduct these at a voltage reasonably similar to the working voltage of the components under test, and this is commonly of the order of 200 V.

Complete Test Circuit. The complete circuit of the test equipment is shown in Fig. 4. Apart from the inclusion of a means whereby any desired "standard" resistance or capacitance can be switched into circuit, it will be noted that two modifications to the previous circuits have been made. First, the relative positions of the telephone receiver and a.c. source have been interchanged. This has no effect upon the balance of the bridge but results in greater sensitivity when high resistances or low capacitances are being compared. Second, the neon oscillator is coupled to the bridge circuit by means of a step-down transformer. This serves the dual purpose of isolating the bridge and telephones from the power supply and also of helping to match the high impedance of the a.c. source to that of the bridge. The characteristics of the transformer are in no way critical and, since only a very small direct current is passed through the primary, a miniature a.f. component of 3:1 or high ratio is quite suitable.

Terminals Z are normally short-circuited and are employed only when insulation tests are being conducted. The selector switch SW for "standard" resistors, etc., is provided with an open-circuit position so that terminals S can be connected to any desired comparison component for special purposes.

With the change-over switch in position A the bridge covers ratios from unity to infinity, whilst in position B the ratios range from unity down to zero. For capacitance tests the switch positions are reversed.

Construction. The lay-out of the components is in no way critical and may be such as to give a maximum compactness with the particular articles available. Undue capacitive couplings between the wiring should, however, be avoided, and it is most important to ensure that the insulation of the oscillator components and terminals Z is as high as possible. A list of the components is given with Fig. 4.

In the author's instrument the "standard" com-

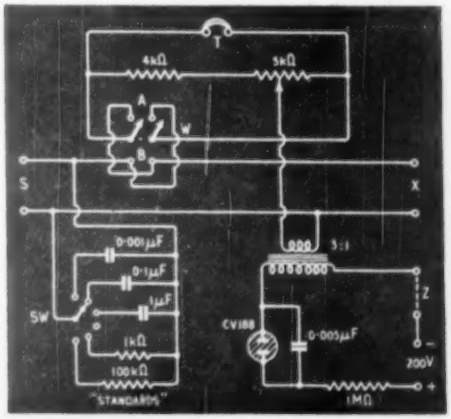


Fig. 4. Complete test circuit.

List of Components

Wire-wound linear law potentiometer, 5,000 Ω.
Fixed resistors—4,000 Ω, 1 watt, 1 MΩ, 1 watt.
D.P.D.T. switch (W).
Six-position S.P. wafer switch (SW).
High-impedance (4 kΩ) telephone receiver.
Telephone plug and jack (or terminals).
A.F. transformer—3:1 or higher ratio.
Neon tube, type CV 188.
Fixed capacitor, 0·005 μF—preferably mica dielectric.
"Standard" components: Resistors, 1 kΩ and 100 kΩ. Capacitors 1 μF, 0·1 μF and 0·001 μF.
Terminals, panel, containing box and calibrated dial.

ponents and selector switch are mounted in the lid of the containing case, which is also provided with a compartment to house a single telephone earpiece and connecting leads. The rest of the components are mounted behind the panel of the bridge proper and the whole instrument is contained in a box measuring 8in × 7in × 4½in externally when closed.

The neon tube specified is actually a voltage stabilizer available as government surplus, but other tubes possessing reasonably similar characteristics can be employed, though minor adjustments to the series resistance and shunt capacitance values may be necessary to obtain a satisfactory oscillation frequency. The striking and extinction voltages of the tube should, however, be in the neighbourhood of 140 V and 100 V respectively.

Power Supply. No power supply has been incorporated in the test equipment, since many readers will already have available a suitable source of d.c. at about 250 V, whilst in other cases it may be desired to use batteries. The very simple circuit of Fig. 5 has been found to be quite adequate to provide the required supply from a.c. mains. The reservoir and smoothing capacitors may be of any capacitance above 1 μF, whilst the 1 megohm variable resistor functions as both a smoothing resistance and voltage controller. In view of the small current demanded, the rectifier could well be of the type employed for providing e.h.t. supplies in television receivers. The smoothing capacitor should, however, be non-electrolytic to obviate excessive voltage drop due to passage of leakage current through the smoothing resistance.

Preliminary Adjustments.—No difficulty should be experienced in getting the equipment to operate satisfactorily. Terminals S should be short-circuited as well as terminals Z and, with switch W in position B, the potentiometer turned to its extreme position farthest from its junction with the fixed resistor R. This ensures a maximum of unbalance and a strong signal in the telephone. A voltage of about 150 is then applied to the oscillator and slowly increased. Oscillation will be indicated by a ticking sound in the telephone which will increase in frequency as the voltage is increased until a suitable note is produced. If the voltage is raised too high the tube may glow steadily and oscillation cease and should this occur before a sufficiently high frequency is obtained the shunt capacitance must be reduced somewhat. It will usually be found that at certain frequencies the telephone response peaks, on account of diaphragm resonances, and such a frequency should be employed for maximum sensitivity.

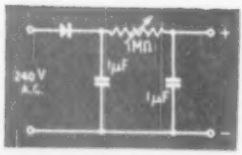
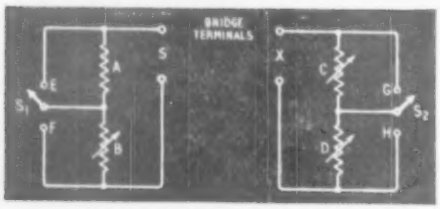


Fig. 5. A.C. power supply.

Fig. 6. Calibration circuit (Procedure 2).



Having obtained satisfactory operation of the oscillator, terminals Z should be open-circuited. This should result in complete cessation of oscillation and if a slow ticking sound persists in the telephone it can be concluded that the insulation of the oscillator circuit is faulty. If so, appropriate steps should be taken to rectify the trouble; otherwise the leakage will be added to that of components undergoing insulation test.

Finally, if available, a high resistance of some 100 MΩ should be connected across terminals Z when a slow ticking sound will show that the leakage resistance across the tube shunt capacitance is sufficiently high to enable the instrument to detect insulation defects such that anything smaller can be ignored for all ordinary purposes. Should no oscillation occur under these conditions the resistance across terminals Z should be reduced until a slow tick is produced. This will indicate the limit of sensitivity of the insulation test and if this proves to be inadequate, attention must be paid to the insulation of the neon tube and its shunt capacitor.

Calibration.—It is, of course, necessary to calibrate the instrument in order to construct either a specially graduated dial giving ratio values direct or, if a uniformly graduated dial is used, a graph by means of which dial readings can be converted to ratio values. The former involves rather more work initially, but renders the bridge much more convenient to use and is well worth while.

Whichever method is adopted, however, the calibration procedure described below can be employed. This depends upon the fact that, apart from small irregularities at the extreme positions of rotation, a linear law potentiometer is such that a given angle of rotation corresponds to the same change in resistance whatever the initial position of the potentiometer contact. From this fact it can easily be established that if F be any bridge ratio value less than unity and Y the angle between the corresponding potentiometer position and that of unity ratio, then the relation between F and Y is given by the expression $Y = K \frac{1 - F}{1 + F}$ where K is a constant for any particular bridge. It follows that a graph of Y against $\frac{1 - F}{1 + F}$ will be a straight line and can therefore easily be drawn provided a few corresponding values of Y and F can be determined. Once such a graph has been prepared it can be employed to determine the angle of rotation required to give any desired bridge ratio, and the problem of calibration is thereby solved.

It is thus necessary only to determine a few fixed points on the bridge and this can be done by either of the two following procedures. If a direct-reading dial is to be constructed the potentiometer should be fitted with a temporary paper scale upon which positions can be marked, and this should first be provided with two diametrical lines at right angles so that the position of the scale centre can readily be located after a central hole has been cut for the potentiometer spindle. Whichever type of dial is used the position of maximum (or minimum) mechanical rotation of the potentiometer should be marked or noted so that

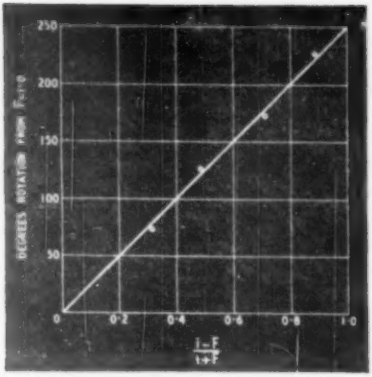


Fig. 7. Typical calibration graph.

if the dial is removed it can be replaced in the same position on the potentiometer.

Procedure 1. This is the simpler procedure but involves the use of resistors of accurately known values. Only a few such resistors are needed, however, and a suitable selection would be the following. 1 kΩ, 1kΩ, 3kΩ and 50kΩ.

With the bridge change-over switch in position B and the selector switch set so as to open circuit terminals S, the dial positions required to balance the following combinations of resistors should be determined.

Resistors in series across terminals S	Resistors in series across terminals X	Ratio F	Value of $\frac{1-F}{1+F}$
1 kΩ	1 kΩ	1.0	0
3 kΩ	1 kΩ, 1 kΩ	0.667	0.2
3 kΩ	1 kΩ	0.333	0.5
1 kΩ, 3 kΩ	1 kΩ	0.25	0.6
50 kΩ	1 kΩ, 1 kΩ, 3 kΩ	0.10	0.818
50 kΩ	1 kΩ, 1 kΩ	0.04	0.923
50 kΩ	1 kΩ	0.02	0.961

From the dial readings thus obtained, or from measurement by protractor, the angles of rotation from unit ratio position can be determined and these plotted against the corresponding values in the final column of the above table. The points thus plotted should lie on a straight line and the latter should be drawn so as to give the best possible fit.

Procedure 2. This method does not require the use of any accurately known values of resistance, but necessitates the use of a fixed resistor of about 1 kΩ, and variable resistors of about the following resistance values: 2 kΩ, 20 kΩ, and 20 kΩ. The two high-resistance components can with advantage be wired in series with 1·5 kΩ variable resistors to provide fine adjustment, but this is not absolutely essential. Two single-pole change-over switches are also required.

As before, the selector switch of the bridge is set to open-circuit terminals S, and the above resistors are conected to the bridge in the manner shown in Fig. 6 with B = 20 kΩ, C = 2 kΩ and D = 20 kΩ.

The first operation is to determine the position of the potentiometer corresponding to a ratio of unity. With switch S_1 in position F and switch S_2 in position H, resistor C is adjusted to a setting considered to approximate to a resistance of about 1 kΩ. The bridge is then balanced and its setting noted or marked on the scale. The bridge change-over switch W is then reversed when a signal will probably be received in the telephone, in which case the bridge is re-balanced and its new setting noted. The bridge is then set to a position midway between the two positions thus determined, and resistor C is adjusted until no signal is audible. The bridge change-over switch is again reversed, and if a faint signal appears a fresh balance position obtained. The bridge is set to midway between these two positions, as before, and resistor C again adjusted to give no signal. The change-over switch is again reversed and the foregoing procedure continued, if necessary, until the balance remains unchanged by reversal of the bridge change-over switch. When this is so, the resistance C must be equal to the resistance A and the bridge setting must therefore correspond to a ratio of unity. Note or mark this on the temporary scale.

Next move switch S_2 to position G and adjust resistor D until no signal is received, the bridge being left at the unity ratio setting. Resistors A, C and D must then all be equal. Switch S_1 is then opened so as to put resistors C and D in series and the bridge re-balanced with the change-over switch W in position A. This corresponds to a ratio of 2 : 1, or, bearing in mind that the two bridge scales are reciprocals of each other, to a ratio of 0.5 : 1.

The bridge change-over switch is then reversed and, with the bridge setting still at the 2 : 1 or 0.5 : 1 position, switch S_1 is moved to position E and resistor B is adjusted to give no signal. The resistance of B must then be twice that of C plus D or four times A, C or D. Switch S_2 is therefore moved to position G and the bridge re-balanced to give a setting corresponding to a ratio of 0.25 : 1.

Again reverse the bridge change-over switch and, without altering the bridge setting, adjust resistor D to no signal. D must then have a resistance sixteen times that of A and, by moving switch S_1 to position F, the bridge can be re-balanced to a setting corresponding to a ratio of 16 : 1 or 0.0625 : 1.

Next reset the bridge to the previously determined 4 : 1 position, move the bridge change-over switch to position B, and switch S_2 to position H. Adjust resistor C to balance the bridge and thus make its resistance equal to one-quarter of A. Move switch S_1 to position E and S_2 to position G. Set the bridge to its unity ratio position and adjust resistor B to give no signal. Its resistance must then equal that of D, which has already been made equal to sixteen times A. B, therefore, now has a resistance sixty-four times that of C and by moving switch S_2 from position G to H the bridge can be balanced to give the setting for a ratio of 0.0156 : 1 (1 : 64).

Ratio F	Value of $\frac{1-F}{1+F}$
1.0	0
0.5	0.333
0.25	0.600
0.0625	0.882
0.0156	0.969

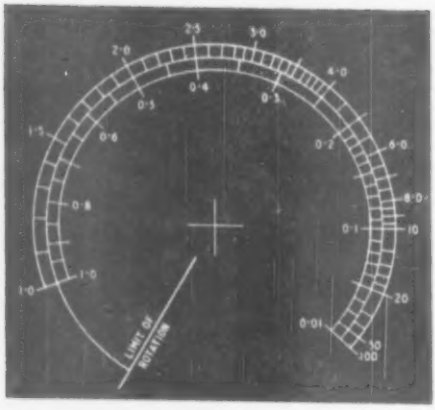
The foregoing procedure, which is much easier to perform than to describe, will have established the bridge settings for the ratios given in the table, and the corresponding angles of rotation from the unity position can therefore be determined and plotted against the values of $\frac{1-F}{1+F}$ as in the first method.

A graph such as that typified by Fig. 7 will thus have been prepared from which the angles corresponding to any values of $\frac{1-F}{1+F}$ can be ascertained. The Table below provides a ready means of converting bridge ratio values, F, to corresponding values of $\frac{1-F}{1+F}$ so that the graph can easily be used for the determination of angles corresponding to any desired values of F.

In the case of a uniformly graduated dial it will be necessary to construct additional graphs showing the ratio values plotted against dial readings, whilst a direct-reading scale can, of course, be constructed by marking in desired graduations with the aid of a protractor.

In both cases the scale readings for ratios above unity are determined by the position of the corresponding reciprocal value on the scale for ratios below unity. A typical direct-reading dial is illustrated in Fig. 8, the calibrations being extended as far as ratios of 0.01 or 100:1.

Fig. 8. Typical direct-reading ratio scales.



Comparison Standards.—To complete the instrument it is necessary to fit the standard components to the bridge selector switch. This demands the provision of at least one resistor and one capacitor of accurately known values, commercially available components of ±1 per cent tolerance being suitable. Given one component of known value of each type, other required standards may be selected, by means of bridge measurements, from available spares. The standards shown in the circuit diagram suffice to cover a resistance range of 10Ω to 10MΩ and a capacitance range of 10pf to 100μF, the highest range being somewhat lacking in precision, but very useful for checking electrolytic capacitors for which great accuracy is not needed.

Insulation Testing.—When it is desired to carry out insulation tests, the 1kΩ standard resistance should be switched across terminals S, the change-over switch moved to position B and the bridge set to a ratio of 0:1 (i.e., fully rotated beyond the 0.01 ratio position). This ensures development of a loud out-of-balance signal.

Terminals Z are then open-circuited and the component to be tested is connected across them. If this has a fair capacitance it is probable that an initial burst of oscillation will be heard as the capacitance charges to the test voltage, but with components possessing first-rate insulation the oscillation will completely cease once charging has been completed. The continued occurrence of a few isolated clicks at a frequency such that they can be easily counted can be regarded as an indication that a leakage resistance of the order of some 100 megohms exists, a value sufficiently high to be ignored for all but the most exacting circuit conditions. With high-capacity components an irregular series of slow ticks may also result from fluctuations in the power supply voltage due to variations in the state of charge of the capacitance, but this effect is unlikely to be mistaken for a serious insulation defect.

If the rate of ticking is such that a low-frequency note is approached, the leakage resistance is of the order of tens of megohms and such components can only be regarded as possibly suitable for use under conditions when good insulation is unimportant. A musical note in any way approaching that of the normal bridge signal indicates very poor insulation.

The instrument can, of course, be used for any kind of insulation tests, such as the inter-winding insulation of transformers, but it is perhaps as well to point out that it cannot be used for checking the leakage of electrolytic capacitors, since this is always of considerable magnitude.

TABLE

Values of $\frac{1-F}{1+F}$ for ratios (F) of less than unity.

F	0	1	2	3	4	5	6	7	8	9
0.0	1.00	0.980	0.961	0.942	0.923	0.904	0.887	0.869	0.852	0.834
0.1	0.818	0.802	0.786	0.770	0.754	0.739	0.724	0.709	0.694	0.680
0.2	0.667	0.652	0.639	0.626	0.612	0.600	0.587	0.574	0.561	0.550
0.3	0.538	0.526	0.515	0.503	0.491	0.481	0.470	0.460	0.449	0.439
0.4	0.429	0.418	0.408	0.398	0.389	0.379	0.370	0.360	0.351	0.342
0.5	0.333	0.324	0.316	0.307	0.299	0.290	0.282	0.274	0.266	0.258
0.6	0.250	0.242	0.234	0.227	0.219	0.212	0.204	0.197	0.190	0.183
0.7	0.176	0.169	0.163	0.156	0.149	0.143	0.136	0.130	0.123	0.117
0.8	0.111	0.105	0.099	0.093	0.087	0.081	0.075	0.069	0.064	0.058
0.9	0.053	0.047	0.042	0.036	0.031	0.026	0.020	0.015	0.010	0.005

"Filters"—A Correction

The shunt arm impedance referred to in line 20, column 2 of page 27 in the January issue should be Z_p, and equation (1) on the same page should read:—

$$Z_0 = \sqrt{Z_1 Z_2} \cdot \sqrt{1 + \frac{Z_1}{4Z_2}}$$

These Valves make News!

THE BRIMAR MINIATURE A.C. RANGE

These high efficiency types feature rugged construction and small overall dimensions, they are fitted with the standard B7G base. Each valve is exactly equivalent to its popular American counterpart and bears the identical number.

Bulb diameter ⅝in. max.
Seated height, 1⅝in. max.

TYPE 6BE6*

Special Heptode Frequency Changer

Heater Voltage	6.3 volts
Heater Current	0.3 amp.
Anode Voltage	250 volts
Anode Impedance	1.0 meg.
Conversion Conductance	0.475 mA/V
Oscillator Slope	7.25 mA/V*

** The exact value depends on circuit conditions.*

TYPE 6BA6

High Slope Vari-mu R.F. Pentode

Heater Voltage	6.3 volts
Heater Current	0.3 amp.
Anode Voltage	250 volts
Anode Impedance	1.5 meg.
Mutual Conductance ...	4.4 mA/V
Anode to grid capacitance	0.0035 pF. max.

TYPE 6AT6

Double Diode Triode

Heater Voltage	6.3 volts
Heater Current	0.3 amp.
Anode Voltage	250 volts
Anode Impedance	58,000 ohms
Amplification Factor	70

TYPE 6AQ5

Output Beam Tetrode

Heater Voltage...	6.3 volts
Heater Current	0.45 amp.
Anode Voltage	250 volts max.
Mutual Conductance	4.1 mA/V
Optimum Load	5,000 ohms
Power Output ...	4.5 watts

Bulb diameter, ⅝in. max.
Seated height, 2⅝in. max.

TYPE 6X4

Full Wave Rectifier

Heater Voltage	6.3 volts
Heater Current	0.6 amp.
RMS Input per Anode ...	325 volts max.
Rectified Current	70 mA max.
Heater—Cathode Potential (Peak) ...	450 volts max.

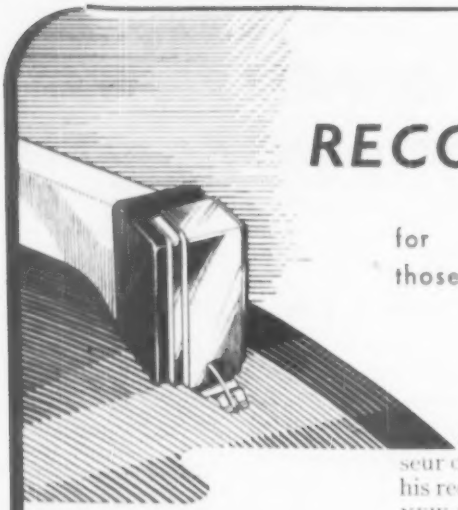
Types 6BE6, 6BA6, 6AT6, may be operated in A.C. or A.C./D.C. equipment. An equivalent range of 0.15 amp. valves will be available shortly, including types 12BE6, 12BA6, 12AT6, 50C5 and 35W4.

BRIMAR

TECHNICAL ADVICE SERVICE

Write to Dept. 4530 for Data Sheets on the above valves.

STANDARD TELEPHONES AND CABLES LIMITED, FOOTSCRAY, SIDCUP, KENT.



RECORD NEWS...

for MUSIC LOVERS & those seeking faithful reproduction

A revelation awaits every serious gramophone user and connoisseur of true fidelity who has not yet heard his records reproduced via the **acos** G.P.20 NEW-TRUE Fidelity Pick-up. Revolutionary in design—and in appearance too—the G.P.20 assures a tonal quality and a brilliance hitherto associated only with laboratory instruments. Moreover, this outstanding performance is attained WITHOUT RECOURSE TO EQUALISERS or other extra components—just connect it to your radiogram or amplifier. Ask your dealer for a demonstration.

With these unique revolutionary features:

Output ½v. at 1,000 c.p.s. —5 to 20 times greater than comparable magnetic types.

❖

Automatic bass-boost —can be fitted to any domestic radio without additional equalisers.

❖

Needle talk and motor rumble negligible.

❖

Low needle pressure—13 grms. — virtually eliminates record wear.

❖

Unbreakable and non-hygroscopic crystal element.

❖

Permanent sapphire stylus eliminates needle change.

acos

GP20 NEW TRUE FIDELITY PICK-UP

Heavy export commitments have severely curtailed supplies of the G.P.20 to the home market. Every effort is being made to increase production and in the meantime we ask your forbearance.

COSMOCORD LIMITED · ENFIELD · MIDDX

Interference from Fluorescent Tubes

By "DIALLIST"

An Obscure Source of R.F. Radiation : Methods of Suppression

IN the January issue of *Wireless World* (p. 38) I made a brief mention of the interference with radio and television reception which may be caused by certain of the fluorescent tubes which are so widely used for lighting purposes nowadays in business premises and in homes. Realizing that the three short paragraphs referred to did little more than touch the fringe of a wide subject, I arranged, with the kind co-operation of Messrs. Belling & Lee, to spend a day in the firm's research department in order to go into the matter more thoroughly. It would obviously be of interest to others besides myself to know more about it. Every reader uses radio receivers of one kind or another and many have television sets as well; the use of fluorescent lighting is increasing rapidly; there is the Wireless Telegraphy Act of 1949, with its clauses prohibiting the use of interference-radiating apparatus . . .

One aspect of the question of the radiation of interference by gas-filled discharge tubes has received adequate treatment by Dr. E. B. Armstrong and Professor K. G. Emeleus of Queen's University, Belfast, in their paper on "The Generation of High-Frequency Oscillations by Hot-cathode Discharge Tubes Containing Gas at Low Pressure."* Their paper, however, is concerned mainly with low-pressure diodes and does not cover the fluorescent lighting tube, the behaviour of which shows important differences.

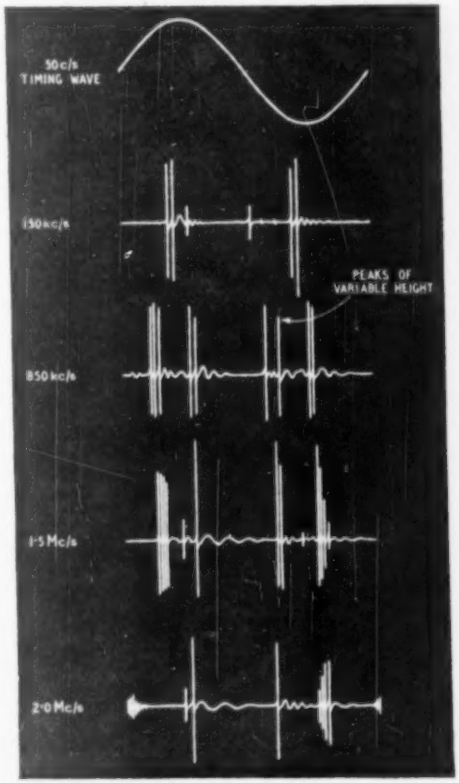
Outstanding amongst the observed facts about the behaviour of fluorescent tubes is that a small percentage of them generate interference with radio and television reception, the effects of which can fairly be described as devastating. The loudspeaker emits intolerable noise; across the screen of the television receiver there appear stationary white horizontal bars. If the receiver is close enough to such a fluorescent tube, the c.r.t. may be so over-driven that the horizontal bars are black instead of white.

The interference is generated by oscillation in the tube. This condition is not produced immediately the tube is switched on. It occurs from 5 to 15 minutes after switching on; and, once it has started, oscillation normally continues. It can be stopped as a rule by tapping the tube smartly. The interference then ceases for a time; but it always reappears, if the tube is one of those prone to oscillate, within 15 minutes.

When a tube is causing interference a noticeably bright spot can be seen on one of the heaters by looking through the narrow strip of clear glass near one or other of the ends. Rapping the tube sharply causes the bright spot and the interference to disappear simultaneously.

The interference is impulsive and the pulses are of very short duration; probably much less than a microsecond. For this reason no clean record may be obtainable on the screen of a cathode-ray oscillograph unless a suitably designed set-up is used. Fig. 1 shows interference waveforms on the screen of a c.r.o. connected across the telephones at the output of a receiver with a bandwidth of 8—10kc/s (6db down). The waveforms shown represent the modulation envelopes corresponding to large numbers of brief pulses. They are those obtained with the re-

Fig. 1. Typical fluorescent-light interference waveforms at various frequencies. C.R.O. connected across telephone terminals at output of measuring set with receiver bandwidth of 8-10 kc/s (6 db down).



* *Proc. I.E.E.*, Part III, No. 43, Sept., 1949; p. 390.

ceiver tuned to 150kc/s, 850kc/s, 1.5Mc/s and 2Mc/s.

The interference occurs at intervals over an enormously wide band of frequencies, extending from less than 100kc/s to well over 3,000Mc/s. Curiously enough, there is no harmonic relationship whatever between the frequencies at which it may be observed. If, for example, there is interference at 800kc/s, it may be absent at 1.6Mc/s, 2.4Mc/s or 3.2Mc/s.

Just how it is caused within the tube is still a matter that needs to be cleared up. There can be no doubt that its point of origin is the bright spot on the heater: if a search coil is moved over an interference-producing tube, the response of the c.r.o. increases as the coil nears the region of the bright spot and diminishes as it is moved away from it; but what exactly is taking place there?

The most plausible suggestion advanced up to now is that the oscillations causing interference are generated at a point (the bright spot, in the case of the fluorescent tube) where there is a small degree of flaking of the surface of the heater or cathode. This might occur with either a plain metal or an oxide-coated electrode. Between the body of the electrode and the flake something of the nature of an arc occurs. It is, again, possible that the flake itself is made to vibrate by the impact of the stream of electrons causing the arc. Inside the tube, it is suggested, there may occur bunchings of electrons, producing a kind of klystron effect. We are certainly concerned with oscillations of considerable amplitude, for Armstrong and Emeleus have shown that the interference radiated by diodes may amount to 1 per cent of the power dissipated at the anode. If this held good for fluorescent lighting tubes, an 80-watt tube could have an interference output of 0.8 watt!

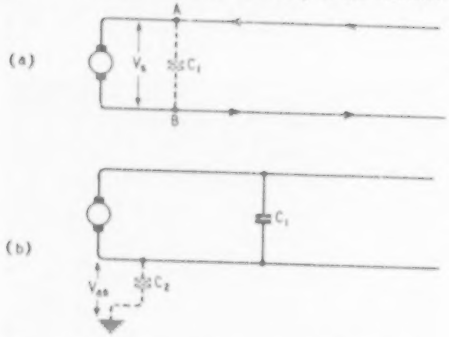
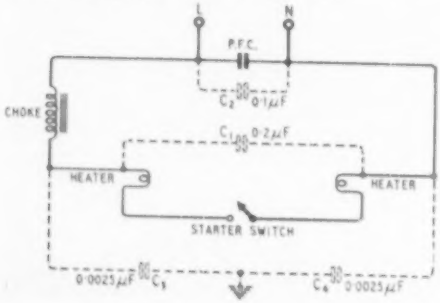


Fig. 2 (a). The symmetric component (V_s) of the generated interference consists of voltages nearly equal and of opposite sign in the two limbs of the circuit. The capacitor C_1 shorts out the interference. (b) Actually, the voltages are not quite equal in the two limbs. There is thus an asymmetric component V_{as} between the circuit, taken as a whole, and earth. This must also be shorted out by a capacitor such as C_2.

Fig. 3. Normal fluorescent type circuit (solid lines) fitted with suppressor circuit (broken lines).



From my own experience and that of others whom I have consulted I don't believe that the unwanted output of an interfering fluorescent tube is anything like so large. Nevertheless, its effect can be sufficient to ruin both radio and television reception.

Interference of many kinds, including that generated by offending fluorescent tubes, consists of two components: the symmetric and asymmetric. Let us take the case of the commutator motor, since this is simple to illustrate. As Fig. 2(a) indicates, the symmetric component of the generated interference appears as equal voltages of opposite sign in the two limbs of the circuit. Were the voltages *exactly* equal, even the vacuum-cleaner and the hair-drier would most likely cause little or no interference with radio or TV. What there was could, in any event, be removed by short-circuiting the voltage differences through the capacitor shown connected between points A and B.

In practice the voltages in the two limbs of the circuit are never precisely equal to one another. The difference between them gives rise to the asymmetric component (Fig. 2(b)), which appears as a voltage difference between the circuit taken as a whole and earth. The problem of suppression, then, becomes one of "shorting out" both the symmetric and the asymmetric voltage differences.

Fig. 3 indicates the way in which this is accomplished by the Belling and Lee suppressor for fluorescent tubes. The solid lines represent the normal components of the circuit and their connections. The additions made by the suppressor, when it has been connected to the circuit, are shown by broken lines.

In this case the two limbs of the circuit are themselves not symmetrical, for that which is (or most certainly should be!) connected to the phase wire contains a choke. For this reason C alone is not sufficient to short out the symmetrical interference component; it is also found necessary to increase the capacitance of the normal power factor capacitor by providing C_2 in parallel with it. Shorting out of the symmetric component thus takes place at both ends of the choke. C_3 and C_4 provide paths to earth from the circuit as a whole for the asymmetric component.

Even if a fluorescent tube does not suffer from "white-spot" trouble, it still radiates, if not suppressed, a small amount of interference owing to the asymmetry of its circuit. If only a single tube is in use, this interference may be so slight as to cause no noticeable effects; but when N tubes are served by the circuits of a building the total interference becomes $\sqrt{N}$ times as great as that from one tube. How effective is this system of suppression will be realized by any reader who visited the recent Exhibition at Olympia. Every one of the hundreds of tubes in use there was fitted with the suppressors described and there was no interference whatever from them with radio or television reception.

Deflector Coil Characteristics

1.—Efficiency in Television Scanning

By W. T. COCKING, M.I.E.E.

THE function of a deflector coil is to produce a more or less uniform magnetic field within the neck of the cathode-ray tube where it can act to deflect the electron beam. The establishment of this magnetic field demands the expenditure of energy, which is stored in the field while it persists. On the collapse of the field part of the energy is dissipated as heat, but part can be returned to the circuit and utilized.

The amount of energy needed depends on the field strength required and the volume of space which it occupies. A certain minimum energy is stored in the field within the glass walls of the c.r. tube and this can be taken as the minimum energy needed for deflection. In no practical case is it possible to produce a field within the tube without also producing one outside it, however, and this external field serves no useful purpose. The energy stored in it is, therefore, waste energy.

Other things, such as defocusing and raster distortion being equal, the most efficient deflector coil is the one which produces the least external field for a given internal field. The importance of minimizing external field may be realized when it is said that only rarely does a deflector coil produce less external than internal field and that it is common for the external field to be several times as great as the internal.

Coil Constants

The importance of deflector-coil efficiency has been greatly increased by the development of the a.c./d.c. television receiver. The h.t. voltage available in this type of set is quite low and it is expensive to obtain large scanning power by increasing the current. One line of attack has been to develop "economy" circuits in which the energy stored in the magnetic field is not all wasted as heat during the fly-back, but is partially recovered. Such circuits, however, demand additional components and an extra valve. They are not, therefore, cheap, although their use may be cheaper than the supply of a heavy current.

The fundamental point of attack should obviously be the deflector coil, for any improvement in its efficiency is immediately reflected in a reduction of scanning power. The simple pursuit of deflector-coil efficiency by itself is not sufficient, however. Not only must the coil remain satisfactory in producing a well-focused and undistorted raster, but its cost of manufacture must be acceptable.

The aim in producing a more efficient deflector coil is not to produce the most efficient coil possible, but to produce the cheapest television receiver. In general, a more efficient coil will mean a coil which is more difficult to make and, therefore, more expensive. It is of advantage only if its use enables a greater saving to be made in the rest of the equipment.

There are many possible ways of making deflector coils, and there is very little published information about their characteristics. One of the main aims of this article is to fill this gap in some degree by giving figures for the performance of the main types. There is no difficulty in measuring the performance of a deflector coil; the great practical difficulty of an investigation lies in the enormous amount of labour required to make the different forms of coil. It may need many hours of mechanical work to effect quite a small change in a design.

The deflector coil has inductance L and series resistance R. For a given deflection under given conditions a peak-to-peak current I is needed in the coil. The peak back-e.m.f. on the scan is

$$\frac{LI}{\tau_1}\left(1+\frac{\tau_1 R}{2L}\right)$$

where τ_1 is the scan period, —84 μsec for the line scan of the 405-line transmissions. With L in millihenrys and R in ohms, this expression reduces to $11.9\,LI\,(1+0.042\,R/L)$ volts. The peak value of the volt-amperes is thus $11.9\,LI^2(1+0.042\,R/L)$.

For the frame scan τ_1 is 19 μsec and the peak back-e.m.f. becomes $0.0525\,LI\,(1+0.5\,R/L)$. It is better written $0.5\,RI\,(1+0.105\,L/R)$ and the volt-amperes as $0.5\,RI^2(1+0.105\,L/R)$.

In practice, R/L usually lies within the limits 0.5 and 2 and is generally around 1 to 1.5. With an error of less than 10 per cent, therefore, the factors in brackets can be taken as unity and the line scan volt-amperes are approximately $11.5\,LI^2$ and the frame $0.5\,RI^2$.

The figure for LI^2 is indicative of the energy needed to establish the magnetic field; and the smaller the figure obtained the more efficient is a deflector coil. Since resistance losses are usually unimportant at line frequency the LI^2 figure is a convenient indication of the merit of a coil. At frame frequency, however, the opposite condition exists and the resistance losses greatly exceed the field energy. The figure for RI^2 is in this case a measure of the power needed for deflection; the LI^2 figure is still useful, however, for it is indicative of the merit of a coil in producing useful field. Consequently, it is often desirable to consider RI^2 as the product $LI^2 \times R/L$.

While at line frequency efficiency can be improved only by reducing LI^2, at frame frequency it can be increased by reducing either LI^2 or R/L. In fact, it may sometimes happen that an alteration which decreases the field efficiency enables the resistance/inductance ratio to be so much reduced that the total efficiency is improved.

It is, therefore, necessary to consider the line and frame coils to a large extent separately. Nearly everything that is said about the efficiency of line-

scan coils applies also to the field efficiency of frame-scan coils but not necessarily to their total efficiency. It is to be noted also that while the RI^2 figure is indicative of the inherent efficiency of a frame-scan coil, it is not always a true measure of the merit of a coil when considered in conjunction with the circuit which feeds it. There are cases where circuit economy may require a deflector coil which does not have the lowest attainable RI^2 figure.

At first the question of field efficiency only will be considered. All inductance figures quoted are in millihenrys and currents are in amperes. The energy in the magnetic field in joules is, therefore, 0.0005 times the LI^2 figure; and, at a scanning frequency of 10,125 kc/s, the power in watts is $5.0625\ LI^2$, assuming that the energy is all dissipated in resistance during the fly-back. In all cases, the current is the peak-to-peak amplitude of saw-tooth current needed to give a deflection of $7\frac{1}{2}$ in measured across the curved face of a Mullard MW14-c tube operating at 5 kV.

The whole matter of deflector-coil design resolves itself into obtaining the smallest LI^2 figure compatible with a satisfactory mechanical construction and negligible defocusing and raster distortion. The attainment of a low LI^2 figure is essentially a matter of avoiding waste field.

The simplest form of deflector coil is the air-core type, but it is of limited utility because of its poor efficiency. It necessarily produces a very large external field. The efficiency can be at least doubled by the use of an iron circuit. This increases the inductance, which is undesirable, but reduces the current so much more that the net result is an improvement. With some iron-circuit types the addition of copper screens enables the increase of inductance due to the iron to be partially offset and a further improvement can be made. It is to be noted that such screens are effective only at line frequency, not at frame.

There are two basic forms of iron circuit, which will be designated the iron-ring and iron-core types. The iron-ring is usually a stack of laminations which fits around the centre part of the coils which are themselves much the same as in air-core types. An air-core assembly (line-coils only) is shown at (a) in Fig. 1 and with an iron-ring at (b). The rectangular stack forming the "ring" is often rectangular outside and circular inside. The iron-core type is shown at (c). The core is a stack of circular laminations and the winding is around the iron circuit itself. The laminations need not be circular; indeed, rectangular are more frequently used, as shown at (d).

The iron-ring and iron-core types are so different in their construction that it is very important to realize that inside the window of the iron circuit they are identical. The main deflecting field is produced inside the iron circuit by the straight wires

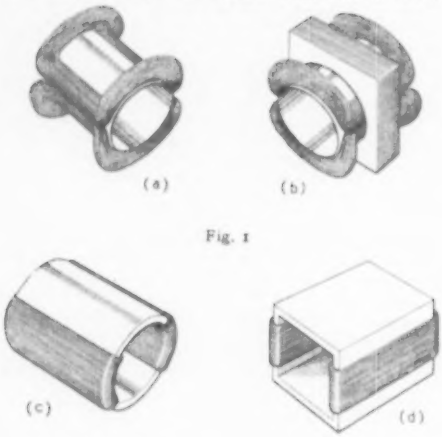


Fig. 1

Fig. 1. The pair of bent-up end coils forming an air-core deflector coil for the line scan is shown at (a) and the same coils with an "iron"-ring at (b). An iron-core coil with the windings around a stack of circular laminations is illustrated at (c) and with square laminations at (d).

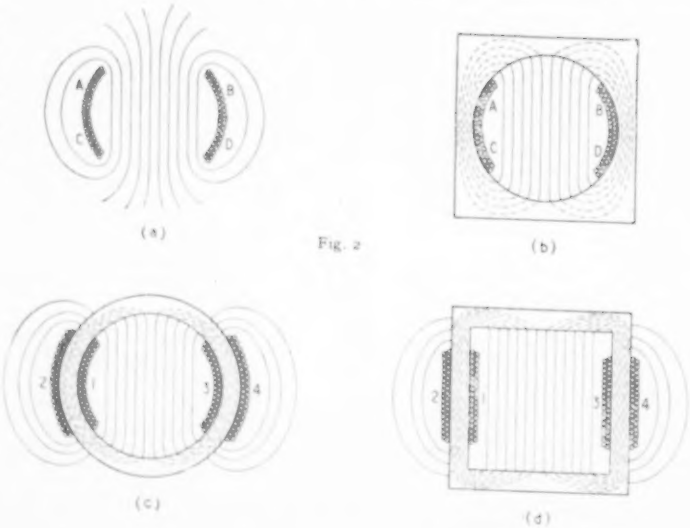


Fig. 2

Fig. 2. Cross-sections through the centres of the coils of Fig. 1 are shown here together with an indication of the magnetic fields. Reference letters are the same as in Fig. 1.

which lie between the iron and the neck of the tube.

In all the coils of Fig. 1 parts of the whole coils are formed by sets of wires which lie alongside the neck of the c.r. tube. Cross sections through the centres of the various assemblies are shown in Fig. 2. In the air-core coil (a) the sets of wires A and B form the go and return paths for current in the upper coil of Fig. 1 (a), while C and D are the go and return paths for the lower coil. If the current flows upwards out of the paper in A it does so also in C, and flows downwards into the paper in B and D. The end connections between A and B and between C and D are made through the bent-up end wires passing outside the neck of the tube.

In an iron-ring coil, Fig. 2 (b), the coils are identical but the field external to the coil is substantially confined to the iron ring. It requires so much less energy to establish a field in iron than in air that the energy needed for the return field in the iron is negligibly small compared with that needed for the field in the air gap closed by the iron. The waste external field of the centre part of the air-core coil is virtually eliminated by the iron ring.

In the iron-core coil of Fig. 2 (c) the internal conditions are identical with those of the iron-ring coil (b). The windings of one coil are 1 and 2 and of the other they are 3 and 4. The wires of 1 are identical with A and C of Fig. 2 (b) and the wires of 3 are identical with B and D. If current flows upwards in 1 and 4 it flows downwards in 2 and 3.

External and End Fields

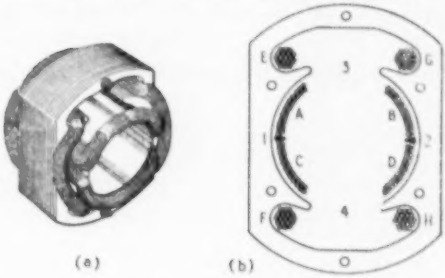
Internally there is no difference at all between the iron-ring and iron-core types. Externally there is quite a big difference, for the iron-core coil produces a large external field. This can, however, be greatly reduced by a close-fitting external metal shield in which eddy currents produce an opposing magnetic field. At line frequency such a shield can double the efficiency of a coil, but at frame frequency it is ineffective.

The iron-ring coil does not produce this external field, but instead it produces end fields quite different from those of the core type. In coils with an iron circuit, the waste field is largely produced by the connections between the side wires [A, B, C, D of Fig. 2 (b) and 1, 3 of Fig. 2 (c)]. These connections are 2 and 4 of Fig. 2 (c) but are the bent-up ends of the ring type.

In both core and ring types the field produced by the end connections of the side wires is waste. Unless the deflector coil is unusually short the length of wire involved in these end connections is greater for a core-type coil than for a ring type; in addition, the wire of these end connections is usually nearer the iron of the core than in a bent-up end coil. As a result, a core-type coil is usually less efficient than a ring type. At line frequency external copper screens are usually more effective in reducing inductance with the core-type of coil but, even so, the ring-type is still the more efficient.

The writer has not carried out measurements on very short deflector coils (coils with a length of under, say, 1 in as compared with the usual 1½-2 in) but it is not improbable that the core-type of coil would then be relatively much better, for it would have the shorter end connections of the two. However, the reduction of length would in itself so reduce the efficiency that such short coils would never be used unless some special requirement made them otherwise necessary.

Fig. 3. (a) Assembly in which the pole-pieces of the frame deflector act as an iron-ring for the line; Sketch (b) represents a section through the assembly.



The most widely used deflector coil for television is the iron-ring type and the core-type is comparatively rare. A hybrid version, in which the iron acts as a ring for the line coils and as a core for the frame coils, is more common but its use is not nearly as widespread as the ring type. A slotted-ring type is also sometimes used, but again only rarely. This is like the ring type described but the stack of laminations has longitudinal slots on its internal face and the wires of the coils lie within the slots. The object is to increase the efficiency by bringing the iron nearer to the neck of the tube.

Still another form of deflector coil has iron pole pieces for the frame deflection. It is sketched in Fig. 3, the complete assembly at (a) and a section through it at (b). The line coils are of the ordinary bent-up end type, the sections through the internal wires being A, B, C and D. The iron poles 1 and 2 form part of an iron ring which is not complete, but is gapped at 3 and 4. The frame coils are E, F, G and H, and are wound around the poles, the magnetic path being completed by the external part of the laminations.

This type of assembly has been used for television but, as far as the writer can trace, there is not a single example of it now to be found. The most probable reason is that it is more expensive.

There is still one other general form—the tandem type. Here the line and frame structures are quite independent and mounted in tandem so that the electron beam passes first through one (usually the line) and then through the other. The main advantage is the very low degree of coupling which need exist between the two deflection assemblies and it is normally used only when the coils are fed directly from self-oscillating current generators. With these coupling between the line and frame generators can seriously affect the performance, but with more normal circuits, embodying amplifiers between the saw-tooth generators and the deflector coils, coupling is relatively unimportant.

Because the line deflector can be designed without having to consider frame requirements, the line-scan efficiency of the tandem type can be higher than in the usual combined assembly. The frame efficiency is usually very poor, however, and it is usually more difficult to secure freedom from defocusing.

(To be continued)

SHORT-WAVE CONDITIONS

January in Retrospect : Forecast for March

By T. W. BENNINGTON (*Engineering Division, B.B.C.*)

DURING January the average day-time maximum usable frequency for these latitudes was considerably lower than during December, whilst the average night-time m.u.f. increased slightly, as compared with the previous month. The reason for these variations is not very obvious, since there was little change in the sunspot activity.

Day-time working frequencies remained relatively high, though the highest frequencies actually propagated seemed to decrease as the month progressed. During the first week American police transmissions on 38-40 Mc/s were frequently received in this country, but by the last week 30 Mc/s appeared to be the highest frequency being generally propagated over this path. The 28-Mc/s band was usable on undisturbed days over most circuits. The highest night-time working frequencies *regularly* usable were of the order of 8 Mc/s.

Sunspot activity was, on the average, slightly higher during the previous month.

January was another relatively quiet month, and only one ionospheric storm of the severe type appears to have occurred, on 24th-25th. Storms of minor intensity took place on 7th, 14th-15th, 20th-21st, and 30th-31st. A severe Dellinger fadeout occurred at 1105 on 20th, but no others have yet been reported.

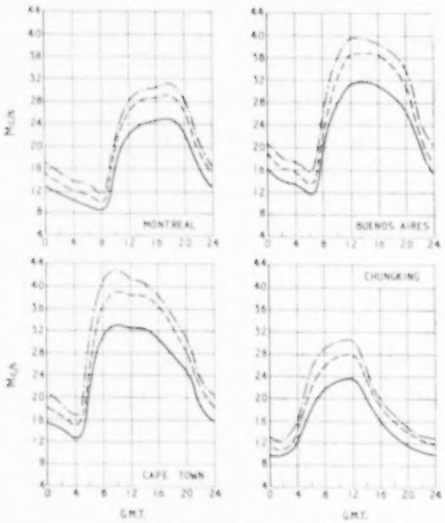
Forecast.—During March there should be a decrease in the day-time m.u.fs. in these latitudes, and a considerable increase in those for night-time.

Day-time working frequencies over nearly all circuits should, therefore, be somewhat lower than during February, and frequencies like 28 Mc/s should become less frequently usable over east-west paths. Over north-south paths, however, they should still be *regularly* usable. Day-time frequencies should remain operative for considerably longer periods than during February, due to the lengthening hours of daylight in the northern hemisphere. At night, 11 Mc/s should remain usable over most paths till after midnight, and 9 Mc/s should be the lowest frequency really necessary at any time of night.

Over medium distances the E layer may control transmission for an hour or two around noon, but Sporadic E transmission is not likely to be frequent.

March is often a bad month for ionospheric storms, and some periods of severe disturbance should be expected.

The curves indicate the highest frequencies likely to be usable over four long distance circuits from this country during the month.



NEW BOOK

High-Frequency Heating. By L. Hartshorn, D.Sc., A.M.I.E.E., A.R.C.S., D.I.C. Pp. 237; figs. 102. Allen & Unwin, 40, Museum St., London, W.C.1. Price 21s.

IT is lately the fashion for technical books to be written with a cold impersonal style intended to imply efficiency. It is a welcome change to read a book written in narrative prose, particularly one in which the prose is well packed with meaning. This no doubt arises from the book having been based on lectures; it is unfortunate that this foundation has led to a rather unevenly detailed treatment of the subject. For instance, the generation of radio-frequency power for heating purposes is not just a very simple aspect of radio transmitter design, but a new subject full of its own pitfalls; but this book says all too little about it. Perhaps the title of the book is misleading: most of the books on r.f. heating deal with the theory and design of oscillators in as much detail as they deal with their use; this book is less ambitious.

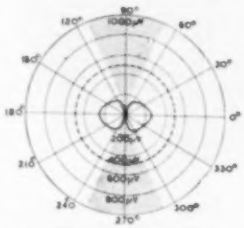
For it is on r.f. heating applications that the book is most attractive. Whether the author has had personal experience of every single job that he writes about or whether he has skillfully abstracted some of it from the varied and copious bibliography is hard to tell; but he provides authoritative information on a variety of r.f. heating applications ranging from stock examples such as hardening steel tools to unexpected ones such as drying cabbage leaves, and on each subject he provides in a condensed and palatable form all that a worker in these fields needs to know before he can safely start collecting experience of his own. Practical details and enough of the underlying theory are given so that the reader can appraise the orders of magnitude involved in the various uses of r.f. heating: it should be a help in avoiding the waste of time which occurs in trying to apply r.f. heating in cases where it is quantitatively or qualitatively unsuitable.

To anyone interested in "application" work this book is whole-heartedly recommended. To anyone interested in packing readable facts into a small space this book should serve as an object lesson.

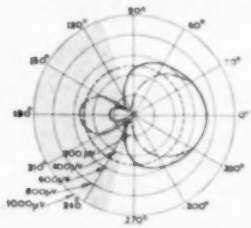
A. H. C.

THE "BELLING-LEE" PAGE

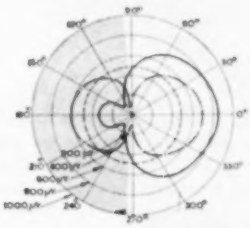
Providing technical information, service and advice in relation to our products and the suppression of electrical interference



INVERTED 'V' DIPOLE SOUND & VISION SHOWN—



λ/7 'H' LIGHTWEIGHT CONVENTION SHOWN BELOW



λ/4 'H' SENIOR CONVENTION SHOWN CENTRE COLUMN

Polar Diagrams

In future, aerial polar diagrams issued by "Belling-Lee" will express the response of the aerial in microvolts in a given field, and not in decibels referred to minimum response.

The change will make the diagrams more easily read and understood by a larger number of people, who may not have the necessary appreciation of logarithmic notation. When shown in microvolts, the comparison of the polar diagrams of two different aerials will be seen at a glance, since a linear scale is used. If one aerial has twice the pick-up in one direction compared with another aerial, the distance in the appropriate direction from the centre of the diagram to the response curve of the aerial will be twice the corresponding distance in respect of the other.

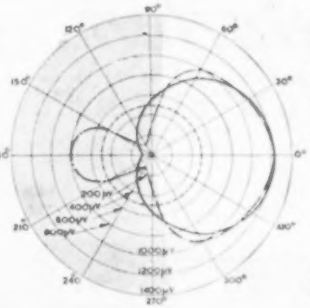
It all depends upon the point of view

Quite recently our installations department was called in to "put the aerial the right way round". On making enquiries, it appeared that the picture was fine, but captions were reversed. We explained that this had nothing to do with the aerial, and quite an argument ensued. We suspected an over-enthusiastic service man had adjusted the receiver from the back, using a mirror in front of the tube. We could not satisfy the representative of the dealer in question, so our engineer, in defiance of all his instructions but defending his reputation, borrowed a soldering iron and reversed the line scan coils which corrected the fault. Whereupon the dealer's representative commented "of course, that's one way of doing it". This is a *true* story.

Bandwidth

We are often asked if the bandwidth of one of our aerials is such as to allow a receiver to resolve 3 Mc/s. The answer is yes, provided that the aerial has been carefully installed and correctly terminated. It should be remembered that bandwidth depends upon the aerial, the feeder, method of termination and the input arrangement of the receiver. The last detail being beyond our control.

The highly directional "Multirod"*1 is often suspected, but as it includes a carefully designed matching stub, there need be no doubts on this score. The engineer in charge of our installation department is emphatic that he has not come across a single case where a "Belling-Lee" "Viewrod"*2 has failed on this account.



4-ELEMENT ARRAY

——— VISION DIAGRAM
- - - - SOUND DIAGRAM
..... DIPOLE DIAGRAM

Indoor aerials, and specially the "Doorod"*3 and "Viewflex"*4, may have their bandwidth degraded by the proximity of metal objects etc., but it is doubtful if, in the circumstances for which the types are sold and installed, the degree of degradation would be such as to detract from pleasure of the user.

Opinions damaging to the industry

We have heard of people in low-lying towns a hundred miles from Alexandra Palace, who agree with the local authorities about 'H' type aerials spoiling the skyline. They also suggest that these aerials are unnecessary because they have heard of people in London who receive television programmes using only an indoor aerial. It seems incredible that such views can be held and spread around without due thought given to the damaging effect on the industry.

We advertise in literature and through the press that no indoor aerial is recommended for use in districts over 10—15 miles from the transmitter except where signal strength is known to be high. This reminds us of a telephone conversation with an irate gentleman who declared that our "Doorod"*3 indoor aerial was a swindle. He was speaking from a town over fifty miles from the transmitter.

*1 **"MULTIROD"** L698 (L) L699 (M) 278/-

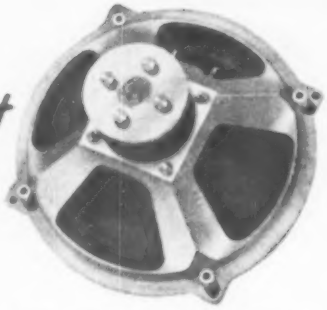
*2 **"VIEWROD"** "H" type from 50/-

*3 **"DOOROD"** indoor type from 26/6

*4 **"VIEWFLEX"** indoor type from 17/6

BELLING & LEE LTD
CAMBRIDGE ARTERIAL RD., ENFIELD, MIDDX., ENGLAND

Thanks for the bouquet



SIX months ago we announced that, due to reorganisation of our manufacturing programme, we were able to offer our 12" Speaker Chassis to a far wider field. The response to that announcement — and the very flattering remarks we have subsequently received — have far exceeded our expectations. Bouquets are rare in this business, but they are very welcome. Thank you — so much.

Highest distortion-free performance — accurate reproduction over widest possible audio-frequency range. Magnet of "Alcomax", the most efficient anistropic alloy. Die-cast chassis. Flux density: 13,500 gauss. Total flux: 106,000 gauss. Speech coil impedance: 15 ohms. Handling capacity: 15 watts.

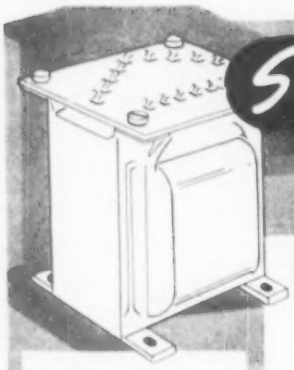
Price £6-6-0 (without transformer)
£7-7-0 (with transformer)

W B

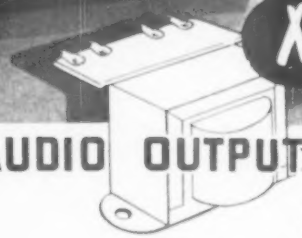
Stentorian

LOUDSPEAKERS AND RADIO EQUIPMENT

WHITELEY ELECTRICAL RADIO CO. LTD · MANSFIELD · NOTTS



Somerford and Miniford



AUDIO OUTPUT TRANSFORMERS

These two standard ranges of Output Transformers will meet all the normal needs of the home constructor. They provide a degree of accuracy, quality and dependability which cannot be surpassed.

★

CHARACTERISTIC CURVES

of Somerford Transformers showing frequency response between 20 cycles per second and 25,000 cycles per second are available upon request.

SOMERFORD. A range of Output Transformers designed to ensure high quality and reliable performance. Suitable for single ended or push-pull circuits, they cover the widest limits of the audio frequency band. May be used with confidence for the most exacting circuits.

MINIFORD. A range of high quality transformers of economical design which provide excellent reproduction for domestic purposes, but over a more restricted range of audio frequencies than the Somerford Transformers. 2, 4 and 8 watt types suitable for all outputs.

Write for our latest Folder giving complete details of the SOMERFORD and MINIFORD Transformers

GARDNERS RADIO Ltd

SOMERFORD · CHRISTCHURCH · HANTS

Phone: CHRISTCHURCH 1025

WORLD OF WIRELESS

Standard Frequency Service • Television News • Europe's Wavelengths • National Radio Show • French Television

U.K. Standard Frequencies

AS a result of investigations carried out by a committee under the chairmanship of Dr. R. L. Smith-Rose (Director of Radio Research, D.S.I.R.), a daily experimental service of standard frequency transmissions was inaugurated on February 1st. The G.P.O. has assumed technical responsibility for the transmissions which will be radiated from the Rugby station using the call sign MSF.

The frequencies to be used are 60 kc/s, 5 Mc/s and 10 Mc/s, with a power of 10 kW. The transmissions on 60 kc/s should be received throughout the United Kingdom and Western Europe. Those on 5 and 10 Mc/s form part of an international plan designed to give reliable world coverage on one or other of the six frequencies (2.5, 5, 10, 15, 20, 25 Mc/s) which have been allocated to standard frequency services. The transmissions on these frequencies from the U.S.A. National Bureau of Standards' station WWV are not always satisfactorily received in this country and farther east. It is hoped to learn from the new experimental service to what extent reception in the European area is improved and also to what extent the usefulness of both the U.S.A. and U.K. transmissions may be impaired by mutual interference.

The frequencies, which are to be maintained within two parts in one hundred million of the nominal values, will be monitored at the National Physical Laboratory, and all enquiries or comments concerning the transmissions should be addressed to the Director, National Physical Laboratory, Teddington, Middlesex. Information about reception conditions and any interference with the U.S.A. transmissions, which may be experienced, will be particularly useful.

The present schedule (G.M.T.) is 0544-0615 on 5 Mc/s; 0629-0700 on 10 Mc/s and 1029-1045 on 60 kc/s. The first minute of each transmission period is devoted to the call sign in slow morse and a speech announcement. Then the following fifteen-minute cycle is repeated: carrier modulated with 1,000 c/s for five minutes; the carrier unmodulated for nine minutes and the call sign and announcement for one minute.

Television Progress

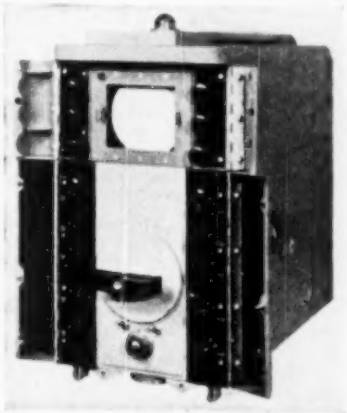
AS referred to elsewhere in this issue, the B.B.C. recently had a "house-warming party" for the five new studios at Lime Grove, Shepherd's Bush, the first of which it is hoped to bring into service in a few months.

Considerable progress is being made in the plans for erecting the remaining two stations to complete the chain of five high-power transmitters. An order has been placed with E.M.I. for the two 50-kW vision transmitters and with Standards for the associated 12-kW sound transmitters for these stations which will be erected in Scotland and the Bristol Channel area. For the Scottish station the B.B.C. is seeking a site at Kirk of Shotts near Harthill, which is almost mid-way between Edinburgh and Glasgow. Tests are in progress in South Wales and North Somerset for the other station.

Work has already begun on the Holme Moss station which is to be equipped with Marconi sound and vision transmitters.

Five new image orthicon cameras are being purchased from Marconi's. This type of camera has already been used by the B.B.C., particularly on outside broacasts—one of the first being the Oxford-Cambridge boat race last year.

The B.B.C. intends shortly to change the picture aspect ratio from the present 5:4 to 4:3 to bring it into line with cinema and foreign television standards. This change will merely involve slight re-adjustment of receiver height and width controls.



CONTROLS and electronic view finder on the Marconi image-orthicon camera as used by the B.B.C. It has a four-lens turret which is controlled from the rear of the camera.

Frequency Re-Shuffle

AT the time of going to press there is still considerable doubt as to the possibility of implementing the Copenhagen frequency plan for Europe's broadcasting stations on the date originally given—March 15th.

It will be recalled that the European medium-wave broadcasting band was extended and will in future be from 525-1,605 kc/s instead of from 550-1,500 kc/s. This extension of the band has, therefore, necessitated the re-allocation of frequencies to other services using the contiguous bands. For instance, the 1,650 kc/s marine distress and calling frequency is being altered to 2,182 kc/s.

No provision was made at Copenhagen for the Airmet transmissions at present radiated on 245 kc/s which in the Plan is allocated to Kalundborg.

Complete details of the Plan were given in the November, 1948, issue of *Wireless World*, and are available from our Publishers as a reprint, price 7½d, including postage. The fifth edition of our booklet, "Guide to Broadcasting Stations" (price 1s 6d), which gives operating details of some 1,300 s.w. stations of the world and of Europe's long- and medium-wave stations, also lists the Copenhagen frequencies.

Broadcasting Committee

IN addition to the oral evidence given by the B.B.C., the G.P.O. and such organizations as the Radio Industry Council and the Listeners' Association before the Broadcasting Committee, it has received written evidence from such bodies as the British Sound Recording Association, the Radio and Television Retailers' Association, the Relay Services Association and the Television Action Committee.

Among the personalities who have

given individual evidence are Sir Robert Watson-Watt and Sir James Shelley—until recently Director of Broadcasting in New Zealand.

A number of concerns who regularly sponsored programmes from Continental stations before the war have given evidence.

"*National*", *not* "*Midlands*", *Exhibition*

PREVIOUSLY announced as a Midlands radio exhibition, the show planned to be held at Castle Bromwich from September 6th to 16th has been enlarged in scope, and will now be known as the 17th National Radio Exhibition. The previous sixteen national radio shows have been held in London.

Its scope will be similar to last year's Radiolympia and, although it is being organized by the Radio Industry Council on behalf of the British Radio Equipment Manufacturers' Association, participation will not be limited to its members.

Physical Society's Show

THE annual exhibition of scientific instruments and apparatus, organized by the Physical Society, will be held for a longer period—including a Saturday—this year. Admission to the exhibition, which will be held at the Imperial College, South Kensington, from March 31st to April 5th, will be by ticket, valid for a specified session, available from Fellows of the Society, exhibitors and learned societies.

The exhibition will be open each morning from 10 a.m. to 1 p.m., and each afternoon from 2 p.m. until 9 p.m., except on the first and fifth, when it will close at 5 p.m.

The catalogue of the exhibits of the universities, Government departments and manufacturers taking part, will be available from the Society at 1, Lowther Gardens, London, S.W.7, price 6s.

High-quality Recording

AT the invitation of the president, W. S. Barrell, members of the British Sound Recording Association were invited to a musical evening at the E.M.I. Studios, on January 14th, and were able to enjoy, under acoustically ideal conditions, a varied programme of disc and magnetic recordings exemplifying the present high standard of the art.

The demonstration was outstanding not only for the excellence of the musical performances, but also for the remarkably low background noise and intermodulation distortion; and from the large attendance, it was obvious that the idea of an entire evening devoted to critical listening found favour as a diversion from the more usual lectures, in which demonstrations form a subsidiary and often tantalizing part.

French Television

IN response to requests from several readers, we give below the times (G.M.T.) of transmissions from the medium-definition (455-line) Paris television station. The vision carrier frequency is 46 Mc/s and the sound carrier 42 Mc/s; the powers are 30 kW and 5 kW respectively.

1000-1100.—Sunday.
1145-1220.—Tuesday to Saturday.
1630-1730.—Wednesday and Thursday.
1630-1800.—Saturday and Sunday.
2000-2200.—Daily.

Programmes from the new 819-line transmitter—radiated from the Eiffel Tower on 183.25 Mc/s (vision) and 174.1 Mc/s (sound)—are broadcast from 1330 to 1530 from Tuesday to Friday.

B.B.C. Labour-Saving

IN order to lower its engineering staff costs, the B.B.C. has introduced two labour-saving ideas into the sound broadcasting system; unattended low-power transmitters and automatic quality-checking monitors.

The present unattended transmitters, which are remotely controlled and have duplicate sets of equipment, have proved as reliable in operation as attended transmitters; whilst in the future, even greater reliability may be obtained by the use of transmitters with multiple units working in parallel.

Automatic monitoring of a programme is achieved by comparison with another source of the same programme whose quality has been checked by a human monitor, any discrepancies being arranged to sound an alarm. By the end of 1950, this system is expected to release 26 men from the Home Service alone.

AERIAL ARRAYS on Torshavn, one of the Faroe Islands, erected for the inter-island V.H.F. radiotelephone system installed by Marconi's.

PERSONALITIES

Lord Burghley, who is chairman of A. C. Cossor, Ltd., and this year's president of the Radio Industries Club, is leading the industrial mission to Pakistan, which is being sent at the invitation of the Pakistan Government.

Sir Robert Watson-Watt, whose nomination as vice-president of the American Institute of Radio Engineers was announced in September, has now been elected to serve for 1950.

Prof. Arthur Porter, M.Sc., Ph.D., who went to the Military College of Science at Shrivenham, Wilts, as the first occupant of the chair of instrument technology, has been appointed director of research in the Canadian branch of Ferranti's. During the war he worked in various Government research establishments, including the Radar Research and Development Establishment.

C. Holt Smith, B.Sc., has been appointed Professor of Instrument Technology at the Military College of Science in succession to Professor Porter. He was at the Royal Aircraft Establishment, Farnborough, from 1926 to 1939, when he went to the B.B.C. Research Department for eight years. In 1938 he returned to Government service and since then has held various technical administrative positions in research establishments, including R.A.E. and T.R.E. His work has been largely associated with radio and radar navigational aids for aircraft.

V. M. Roberts, B.Sc., who is manager of the Electronic and Sound Sales Department of B.T.H. and also director of Multi-Broadcast (Engineering), Ltd., has been elected chairman of the Council of the Radio Communication and Electronic Engineering Association for this year. **K. S. Davies,** general manager of the Electronics Division of Murphy, is the new vice-chairman.

Derrick Murdoch has resigned from the position of joint general sales manager of the Truvox Engineering Co. to undertake export research on behalf of manufacturers. He is visiting the United States in March and enquiries from radio manufacturers should be sent to 46, Dover Court, Manor Street, Chelsea, London, S.W.3.

C. G. Allen (G8BG), a director of McMichael Radio, Ltd., has been awarded the Rotab Cup by the Radio Society of Great Britain. It is awarded annually to the amateur who, in the opinion of the R.S.G.B. Council, has made outstanding long-distance transmissions during the year.

IN BRIEF

Licences.—An increase of 33,000 television licences was recorded during December. The number of television licences current at the end of the year was 349,700—an increase of 146,900 during the year. The total number of licences—both sound and vision—on December 31st was 12,181,300 compared with 11,456,800 a year ago.

E.H.F. Television.—Experimental transmissions of television in the 529-

515 Mc/s band have begun from the U.S. National Broadcasting Company's station, near Bridgeport, Conn. The 1-kW station, KC2XAK, is to re-transmit the regular programmes from WNBT(TV) and special receivers are being installed at selected homes within an area of 25 miles for field tests.

Another Transmitter, replacing the emergency station erected in Liverpool in 1940 and since the end of the war used to radiate the Third Programme, has been brought into use by the B.B.C. The new station, which is in Birkenhead, comprises a 1-kW transmitter feeding a "T" aerial supported by two 126-ft tubular steel masts. The transmitter, which operates on 1,474 kc/s, is remotely controlled from Broadcasting House, Manchester. A second transmitter will later be installed as a standby.

R.C.E.E.A. Report.—The annual report of the Radio Communication and Electronic Engineering Association records that communications gear, broadcasting transmitters, navigational aids and industrial electronics to the value of £3.25 million was exported in the first nine months of last year. The Association, which is one of the four constituent bodies of the Radio Industry Council, has prepared a simple 10-colour wiring code which is to be published and recommended to members for use in professional communication and electronic equipment.

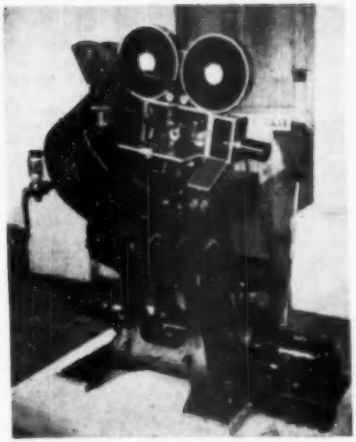
Radio Facilities at the airfields in 110 countries are given in the Aerad Flight Guide issued by International Aeradio, Ltd. It also includes details of lighting and runways and general airport information. It is issued on a subscription basis, which includes the weekly amendment sheets, from 40, Parker Street, London, W.1.

Cathedral Acoustics.—A permanent sound reinforcement system has been installed by Philips Electrical in Canterbury Cathedral, with seventeen microphones and over a hundred loudspeakers, each individually adjusted to optimum level in order to overcome difficulties arising from the 8½-second reverberation time. The system is completely automatic and the number and arrangement of loudspeakers in use is controlled by the switching of individual microphones.

B.I. Callenders.—The Chester branch office of B.I. Callender's Cables is now at 1, Stanley Street, Watergate Street, Chester (Tel.: Chester 306). The company's Cambridge office has also moved. The new address is 61A, Regent Street, Cambridge (Tel.: Cambridge 56318).

Canadian Television.—The transmitters for Canada's first two television stations, to be installed in Montreal and Toronto, are being built by the Canadian associates of two American companies—General Electric Co. and R.C.A. The stations will be operated by the Canadian Broadcasting Corporation.

Marconi Booklets.—Two brochures dealing with Marconi's training facilities have been issued by the company. One, entitled "Marconi College," deals, as its title implies, with the facilities for post-graduate training in radio engineering which is available to those joining the company and also to nominees of associated companies and clients throughout the world. The other—"Marconi Training"—deals with the company's apprenticeship schemes. The booklets are issued from the Education Department, Marconi College, Arbour Lane, Chelmsford.



TELE-FILM RECORDING. One of the cameras recently installed at Alexandra Palace for recording televised events for re-transmission, to which reference is made in the Editorial. A "still" is reproduced on page 84.

Portuguese East Africa.—The British Consulate-General in Lourenco Marques reports that A. G. Simons, Ltd., P.O. Box 363, Lourenco Marques, is interested in securing agencies for British domestic and car receivers.

Import Restrictions on certain products of member countries of the Organization for European Economic Co-operation or their overseas territories have been lifted by Portugal. Among the items listed are transmitting equipment and loudspeakers.

I.E.E. and the Engineers' Guild.—The Council of the Institution of Electrical Engineers made the following announcement regarding the propriety of corporate members of the Institution becoming members of the Engineers' Guild. "The Council wish to remind those concerned that the Institution is not permitted under its Charter to deal with matters of remuneration or conditions of service. A corporate member in his personal capacity is free to decide for himself whether he joins the Guild."

B.I.F.—The 29th British Industries Fair will be held simultaneously at Olympia and Earls Court, London, and at Castle Bromwich, Birmingham, from May 8th to 19th.

G.R.S.E.—Since preparing the note on the Guild of Radio Service Engineers, which appeared on page 58 of our last issue, we have been advised that the registered office of the Guild has again been changed; it is now at Bank Chambers, 6, Station Road, Clacton-on-Sea, Essex (Tel.: Clacton 1549). The new assistant general secretary is G. M. Tedder.

A Radio Relay Record was created by Cable and Wireless when transmitting a photograph of the arrival at Auckland, New Zealand, of the South African Empire Games team on January 23rd. Transmitted from Wellington, the photograph was automatically relayed (not re-transmitted) at Sydney, Melbourne and London for reception in Cape Town, an unbroken journey of some 18,400 miles.

British Overseas Mart.—Under this name an organization has been set up in the United States to market British-made goods. At its headquarters at 1775, Broadway, New York, 19, is a permanent exhibition where British products can be displayed and demonstrated. Among the firms whose products have already been handled by the sponsors, William Carduner and Harry Spinrad, are Multicore Solders and Garrard Engineering. Mr. Carduner is visiting this country in February.

Institute of Physics.—A new monthly journal, *British Journal of Applied Physics*, has been published by the Institute of Physics, the annual subscription for which is £3 (U.S.A. $8.50). Whilst the Institute's other publication, *Journal of Scientific Instruments*, will be devoted to scientific instruments and apparatus, the new journal will deal with new applications of physics and developments of those already known.

All-India Radio has completed another station in its chain of transmitters to provide a broadcasting service to the principal linguistic areas. The station is at Dharwar, Bombay, and radiates Kannada programmes on 840 kc/s.

"Television" is the name of a new technical monthly journal published in France in association with the well-known *Toute la Radio*. Both journals are under the direction of E. Aisberg.

Educational Tours.—Formed for the purpose of providing facilities for engineers and technicians to visit engineering establishments abroad, the Engineers' Educational Travel Club, Ltd., has arranged tours to Scandinavia, Belgium, France and Italy this year. Particulars of membership are available from the Secretary, 35, St. George's Square, London, S.W.1.

R.S.G.B. Officers.—At the recent annual general meeting of the Incorporated Radio Society of Great Britain, W. A. Scarr, M.A. (G2WS), was elected president, and F. Charman, B.E.M. (G6CJ), acting vice-president.

Murphy Television Courses.—Fourteen television training courses, each lasting twelve days, have been planned by Murphy's for their dealers and servicemen for the period March to October. Particulars are obtainable from the Murphy Television School, Welwyn Garden City, Herts.

F.B.I. Register.—The 1949/50 edition of the F.B.I. Register of British Manufacturers, which is produced for the Federation of British Industries, jointly by Kelly's Directories and our Publishers, is now available. It lists nearly 6,000 firms and their products. The main sections of this 807-page directory, which costs 42s, include lists of

trade marks, trade names, addresses, and products and services provided by the manufacturers.

VHF Radiotelephone equipment has been supplied by the G.E.C. to the fleet of dredgers which operate from the Preston, Lancs, dock and work continuously in the River Ribble from Mondays to Saturdays keeping the channel navigable. Single-unit transmitter-receivers are used, working in the 160-Mc/s band. Two-frequency simplex is employed in which the called and calling stations operate on separate frequencies and speak one at a time.

"View Master" Receiver.—An envelope of constructional plans for a Midlands version of the "View Master" television receiver, described in its original form in our issue of December, 1948, has now been issued. The envelope is obtainable from wireless dealers for 5s, or from George Over, Ltd., Market Place, Rugby, for 5s 6d by post.

CLUB NEWS

Birmingham.—At the meeting of the Slade Radio Society on March 3rd, a member of the staff of Premier Radio will describe the construction of a television set using the VCR97 tube. On March 31st a talk on "The Application of Electronic Techniques to Industrial Problems" will be given by a member of British Electronic Products, Ltd. Meetings of the society are held at 7.45 at the Parochial Hall, Broomfield Road, Erdington. Sec.: C. N. Smart, 100 Woolmore Road, Erdington, Birmingham, 23.

Birmingham.—Meetings of the Midland Amateur Radio Society are held at 6.45 on the third Tuesday of each month at the Imperial Hotel, Birmingham. Sec.: W. J. Butler, 32, Pilkington Avenue, Sutton Coldfield, Warwick.

Cleckheaton.—Three meetings of the Spen Valley Radio and Television Society will be held in March. On the 1st B. Marsden will speak on "Microgroove Recording and Quality Amplifiers" and on March 15th H. Reeder (R. N. Fitton) on "Television." The title of the talk to be given by W. T. E. Isaacs (Mains Radiograms, Ltd.), on March 29th has not yet been announced. Meetings are held at 7.30 at the Temperance Hall, Cleckheaton. Sec.: N. Pride, 100 Raikes Lane, Birstall, Nr. Leeds, Yorks.

Coventry.—At the meeting of the Coventry Amateur Radio Society on February 27th, which will be held at the B.T.H. Social Club, Holyhead Road, Coventry, at 7.30, L. Chapman will speak on "Diecasting in Radio Equipment." At the meeting on March 13th F. A. Noakes will speak on "This QSL Business!" Sec.: K. G. Lines, (G3FOH), 141 Shorncliffe Road, Coventry, Warwick.

Sunderland.—Class "C" amplifiers will be dealt with by K. V. Draycott (G2BOI) at the meeting of the Sunderland Radio Society (G3CSR) on March 8th. The fourth of the series of lectures on valve manufacture by members of the staff of the Edison Swan Electric Co., will be given on March 22nd. The subject is "Assembly," and the speaker H. Pattinson. Meetings are held at 8 p.m. at Prospect House, Prospect Row, Sunderland. Sec.: C. A. Chester, 38 Westfield Grove, High Barnes, Sunderland.

MEETINGS

Institution of Electrical Engineers

Radio Section.—Discussion on "Mobile Radio Power-Packs" opened by Air Comdre. R. L. Phillips, C.B.E., on February 27th.

"The Fundamental Limitations of Second-Harmonic Type of Magnetic Modulator as Applied to the Amplification of Small D.C. Signals," by Prof. F. C. Williams, O.B.E., D.Phil., and S. W. Noble; and "A New Theory of the Magnetic Amplifier," by A. G. Milnes, M.Sc. (Eng.), on March 7th.

"The Structure, Electrical Properties and Applications of the Barium-Titanate Class of Ceramic Materials," by Prof. Willis Jackson, D.Sc., D.Phil., on March 15th.

"The Operation and Maintenance of Television Outside-Broadcast Equipment," by T. H. Bridgewater, on March 27th.

Informal Meeting.—Discussion on "The Place of High-Frequency Heating in Industry," opened by C. E. Eadon-Clarke.

The above meetings will be held at 5.30 at the I.E.E., Savoy Place, London, W.C.2.

Cambridge Radio Group.—"A Survey of the Possible Applications of Ferrites," by K. E. Latimer, Ph.D., and H. B. MacDonald, B.E., on February 28th.

"The Acoustics of Studios and Auditoria," by W. Allen, on March 21st.

Both Cambridge meetings will be held at 6.0 at the Cambridgeshire Technical College.

Mersey and North Wales Centre.—Faraday lecture on "Radar," by R. A. Smith, M.A., Ph.D., at 6.45, on March 22nd, at the Philharmonic Hall, Hope Street, Liverpool.

North-Eastern Radio Group.—"Experiences Over Fifty Years," by E. Fawssett, on March 6th.

"The B.B.C. Short-Wave Transmitting Station at Skelton," by S. A. Williams, on March 20th.

Both North-Eastern Group meetings will be held at 6.15 at King's College, Newcastle-on-Tyne.

North Midland Centre.—Faraday lecture on "Radar," by R. A. Smith, M.A., Ph.D., at 7.0, on March 6th, at the Town Hall, Leeds.

"The Motor Uniselector and the Technique of Its Application in Telecommunication," by W. H. Grinstead, M.B.E., at 6.30 on March 14th, at the Yorkshire Electricity Board Offices, 1, Whitehall Road, Leeds.

North Western Radio Group.—"The Electrical Breakdown Strength of Air at Ultra High Frequencies," by J. A. Pim, B.Sc. (Eng.), Ph.D., at 6.30 on March 29th, at the Engineers' Club, Albert Square, Manchester.

Scottish Centre.—"Some Electromagnetic Problems," by Prof. G. W. O. Howe, D.Sc., LL.D., at 7.0 on March 1st, at the Heriot-Watt College, Edinburgh.

South Midland Radio Group.—"Magnetic Amplifiers," by A. G. Milnes, M.Sc. (Eng.) at 6.0 on February 27th, at the James Watt Memorial Institute, Great Charles Street, Birmingham.

"Some Electromagnetic Problems," by Prof. G. W. O. Howe, D.Sc., LL.D., at 7.15 on March 15th, at Warwick House Restaurant, Belle Vue Terrace, Great Malvern.

"A Storage System for Use with Binary Digital Computing Machines," by Prof. F. C. Williams, O.B.E., D.Sc., D.Phil., and T. Kilburn, M.A., Ph.D., at 6.0 on March 27th, at the James Watt Memorial Institute, Great Charles Street, Birmingham.

Rugby Sub-Centre.—"Some Electromagnetic Problems," by Prof. G. W. O. Howe, D.Sc., LL.D., at 6.30 on March 14th, at the Electricity Showrooms, High Street, Rugby.

London Students' Section.—"The Electronic Performance of Simple Mathematical Processes," by R. C. Orford, B.Sc. (Eng.), at 7.0 on March 13th, at the I.E.E., Savoy Place, London, W.C.2.

Television Society

Constructors' Group.—"Interlaced Pattern Generator," by F. Cox (Sobell Industries) at 7.0 on March 9th, at the Cinema Exhibitors' Association, 164, Shaftesbury Avenue, London, W.C.2.

Leicester Centre.—Lecture by member of research staff of Ultra Electric at 7.0 on March 1st.

"Construction and Use of Wobbulators for Alignment of Television Receivers," by R. H. Hibberd, B.Sc. (B.T.H.) at 7.0 on March 22nd.

Both Leicester Centre meetings will be held in Room 104, The College of Art and Technology, Leicester.

British Institution of Radio Engineers

London Section.—"Travelling Wave Tubes," by R. L. Kompfner, Dipl. Eng., at 6.30 on March 3rd, at the London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C.1. (Meeting postponed from February 23rd.)

"High Performance Television Monitors," by J. E. Jacob, B.Sc. (Eng.), at 6.30 on March 23rd at the London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C.1.

West Midlands Section.—"Electronics and the Brain," by H. W. Shipton, at 7.0 on March 1st, at the Wolverhampton and Staffordshire Technical College, Wulfruna Street, Wolverhampton. (Meeting postponed from February 23rd.)

"Radio Interference with Broadcast Reception," by A. A. Devey, at 7.0 on March 22nd at the Wolverhampton and Staffordshire Technical College, Wolverhampton.

North-Eastern Section.—"Electrical Breakdown of Gases at Ultra-High Frequencies," by W. A. Prowse, B.Sc., Ph.D., at 6.0 on March 15th, at Neville Hall, Westgate Road, Newcastle-on-Tyne.

Scottish Section.—"The Limitations of the Loudspeaker," by P. J. Walker, at 6.45 on March 2nd, at the Heriot-Watt College, Edinburgh.

South Midlands Section.—"Electronics and the Brain," by H. W. Shipton, at 7.0 on March 30th, at the Coventry Technical College.

British Sound Recording Association

"Microphones and Balance Technique," by F. W. Alexander, Ph.D., at 7.0 on March 24th, at the Royal Society of Arts, John Adam Street, London, W.C.2.

Institution of Electronics

North-West Branch.—"Improvements in Large-Screen Television," by T. M. C. Lance (Cinema Television) at 6.30 on March 10th, at the Gas Showrooms, The Town Hall, Manchester.

Something to go for ... in a big way!

Many importers, merchants, wholesalers and dealers handling high-quality sound reproduction equipment have gone for VITAVOX in a big way and in the going thereof they have profited to an extent that makes Marxists everywhere mutter in their beards. VITAVOX Loudspeakers and Microphones are available to all in hard, medium or soft currency areas. If you are suffering from cut-off itch, perforated diaphragms, chattering cones, failure in the flutes, booming in the bassoons, pandemonium in the percussions, be protected by the VITAVOX Trade Mark.

The lovely lady depicted above has nothing to do with sound reproduction but she makes a change. If you would like a full-colour 10" x 8" print of her, free of all advertising matter, then write to us to-day.

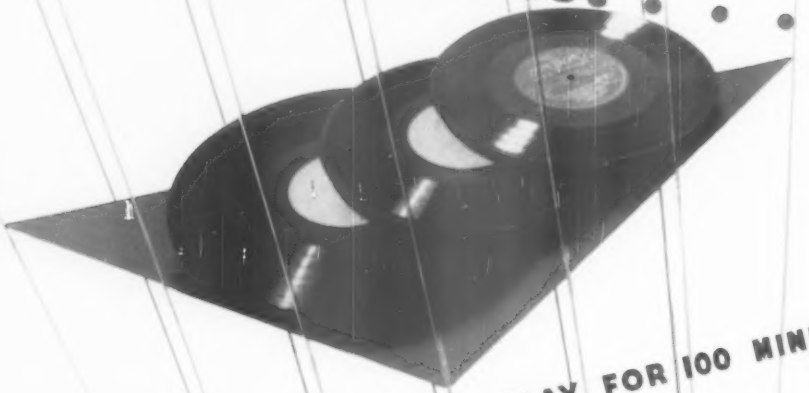
Go for **VITAVOX** *in a big way!*

LOUDSPEAKERS — LOUDSPEAKER PRESSURE UNITS — HORNS — MICROPHONES — BITONE AND KLIPSCHORN REPRODUCERS

VITAVOX LIMITED, WESTMORELAND ROAD, LONDON, N.W.9, ENGLAND. TELEPHONE: COLINDALE 8671. TELEGRAMS: VITAVOX HYDE LONDON. CABLES: VITAVOX LONDON ENGLAND.

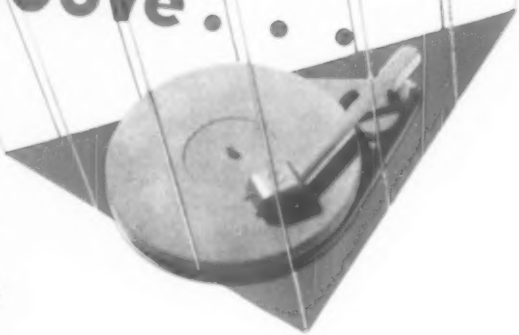
5101

Another BSR 1st . . .



THESE THREE RECORDS PLAY FOR 100 MINUTES

Microgroove . . .



33⅓ R.P.M. LONG

45 R.P.M. PLAYING

78 R.P.M. MOTORS

BIRMINGHAM SOUND REPRODUCERS BSR LIMITED

BRITISH THROUGHOUT

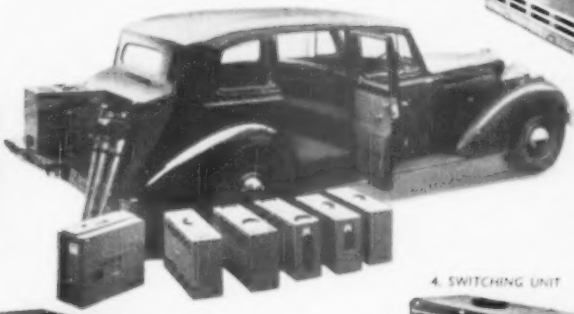
CLAREMONT WORKS, OLD HILL, STAFFS. ENG. GRAMS: 'ELECTRONIC, OLD HILL, CRADLEY HEATH'

A mobile television system with only 7 basic units

The Ship's company of H.M.S. "Amethyst" being entertained at the Guildhall by the Lord Mayor of London.

1. IMAGE ORTHICON CAMERA, with detachable electronic viewfinder.

2. CAMERA CONTROL AND PREVIEW MONITOR



3. POWER SUPPLY UNIT

6 & 7. WAVE FORM GENERATOR (IN TWO UNITS)

4. SWITCHING UNIT

5. MONITOR

These seven lightweight "suitcase" units provide a complete mobile television system. Easily transportable, adaptable and flexible, their exceptional mobility widens the horizon of television. For outside broadcasts or for the specialised applications of television in hospitals, in film studios, or for general application in industry, Marconi television equipment is the finest in the world.

Write for descriptive brochure SP15.

Marconi Television

MARCONI'S WIRELESS TELEGRAPH COMPANY LIMITED, MARCONI HOUSE, CHELMSFORD, ENGLAND

THE MARCONIPHONE RANGE OFFERS

THE GREATEST VALUE IN RADIO

THIS handsome up-to-the-minute radiogram with an effective form of bandspread tuning on short wave is made with alternative waveband coverages. The gramophone unit consists of a 10 record autochanger of entirely new design and the famous Marconiphone Lightweight pick-up. A 10" permanent magnet speaker is incorporated. Generous storage space is provided for record albums. The cabinet is handsomely finished in figured walnut.

★ Model ARG. 23AE/T illustrated, is the auto-radiogram version of a new range of superb 6 valve 5 waveband superhet receivers available for European and Tropical countries.

Waveband Coverages.

Model ARG23AE. (European). S.W. 13.5 — 20, 20 — 34, 34 — 100. M.W. 185 — 575. L.W. 725 — 2000 metres.

Model ARG23AT. (Tropical). S.W.11 — 13.5, 13.5 — 20, 20 — 34, 34 — 100. M.W. 185 — 575 metres.

MARCONIPHONE

THE GREATEST G. Marconi NAME IN RADIO

THE MARCONIPHONE COMPANY LIMITED, HEAD OFFICE HAYES, MIDDLESEX, ENGLAND

M.1642

Vision Transmitter

Equipment at the Sutton Coldfield Station

WITH its peak output of 35 kW the Midlands television transmitter is claimed to be the largest in the world. It has a carrier frequency of 61.75 Mc/s and operates on the vestigial-sideband system, the sidebands below the carrier being retained. The accompanying sound transmitter operates at 58.25 Mc/s.

With the 405-line 50-frame interlaced scanning system used, the modulation frequencies extend up to some 2.75 Mc/s and the vestigial-sideband system calls for the sidebands to be fully transmitted over the range of +0.75 Mc/s to −2.75 Mc/s. Above 0.75 Mc/s the sidebands are increasingly attenuated. The transmitter itself, of course, produces a double-sideband output and the attenuation required above 62.5 Mc/s is obtained by a filter connected in the feeder to the aerial system.

On the radio-frequency side the transmitter starts with a standard-pattern drive unit. This has a quartz-crystal oscillator, to produce a stable frequency, and two stages of frequency multiplication. It produces an output of 5W at 61.75 Mc/s which is used to drive a low-power amplifier. This has three stages—a single-valve pentode stage, a push-pull tetrode stage and a push-pull triode stage with the valves operating as earthed-grid amplifiers. The output from this amplifier feeds the driver stage which has a pair of triodes operating as a push-pull class C amplifier. This stage is neutralized and is designed to produce substantially constant drive on the final stage. The tuned circuit is a resonant line on to which the cathodes of the output stage are tapped through blocking capacitors.

The output stage itself is of the earthed-grid type, neutralized triodes being used in push-pull and water-cooled. Grid modulation is employed, the video signal being applied between grid and earth. The tank circuit is a resonant line from which the output is taken through a coupling loop.

The modulator is fed with the input vision signal at the standard level of 1 V and the pre-amplifier includes stages designed to have an adjustable input/output amplitude characteristic. This is done to compensate for the curvature of the characteristic of the modulated stage and to obtain overall linearity. The correction is of two forms. In one the amplifier is given different slopes above and below black level so that the sync pulses are amplified to a different degree from the picture signal.

The method of doing this is illustrated in Fig. 1 in its basic form. The signal is arranged so that black level in the signal at the junction of R_1 and R_2 is at earth potential, so that the sync pulses are below earth and the picture signal above it. On the sync pulses the diode cathode potential is below that of its anode and it conducts. This clamps the junction of R_1 and R_2 to earth and the amplifier operates with feedback from R_1 only. On the vision signal

Photo at top of page shows general view of the transmitter hall; the vision transmitter is in the foreground.

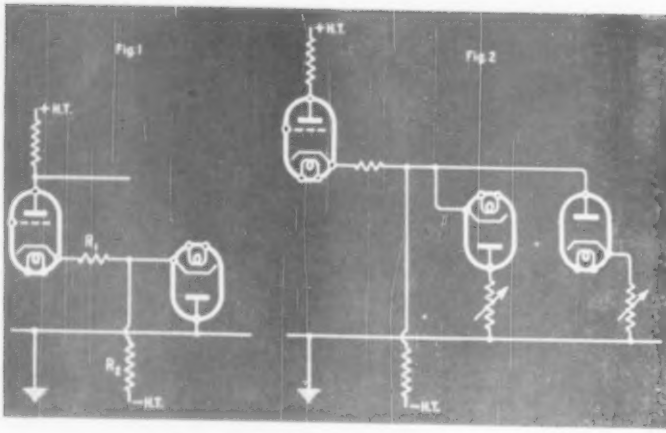


Fig. 1. Basic circuit of stage giving more gain on sync pulses than on the picture.

Fig. 2. Circuit giving independently adjustable gain on sync pulses and on the picture signal. The diodes permit different degrees of feedback to be obtained on the two.

Fig. 3. Balance-to-unbalance and impedance transformer.

Fig. 4. The vestigial-sideband filter comprises complementary high-pass and low-pass filter networks.

Fig. 5. General arrangement of the vestigial-sideband filter.

Fig. 3.

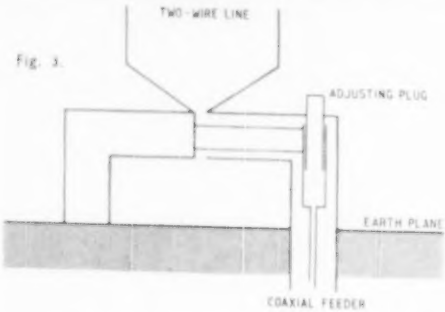
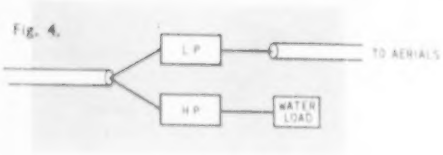


Fig. 4.



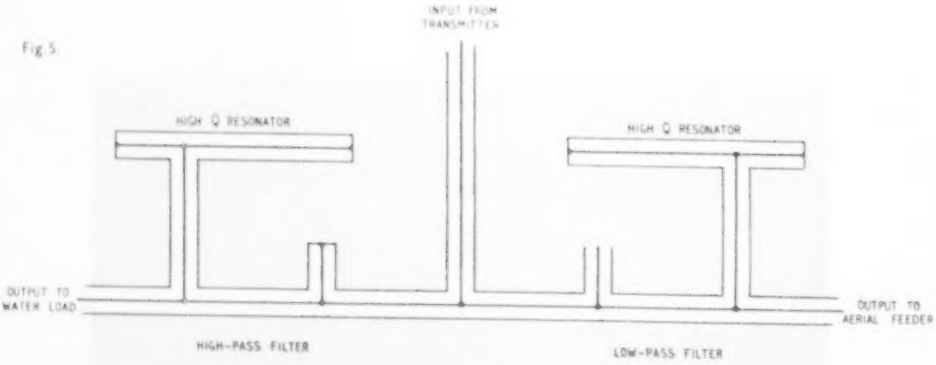
the diode cathode is carried above earth and the diode becomes non-conductive. The amplifier then operates at reduced gain with feedback from both R_1 and R_2. The gain is thus higher on the sync pulses than on the picture signal.

Another stage operating on the same principle enables the gains on the two parts of the signal to be adjusted independently. This is shown in Fig. 2; two diodes are used with series variable resistors. One conducts during the sync pulses, the other during the picture signal. The amount of feedback, and hence the gain, in each condition can be adjusted by the resistors.

The second form of compensation is within the picture-signal range. Several valves are connected virtually in parallel and arranged to come into operation successively as the signal increases. The amplification is so made to increase as the signal increases. The two forms of compensation correct for the inverse curvatures at the two ends of the characteristic of the modulated stage.

The pre-amplifier drives the sub-sub-modulator which consists of a single-valve amplifier with a cathode-follower. In turn this feeds the sub-modu-

Fig. 5.



lator which is of similar design but has a pair of valves in parallel for the amplifier and another pair for the cathode follower.

The modulator itself is a cathode follower with four valves in parallel. It has a very low output impedance, for it has not only to supply the 3.5-A grid current of the modulated stage but also a heavy capacitance current.

At each stage in the modulating equipment provision is made for the connection of a cathode-ray waveform monitor and also for measuring the signal level. Each test point is provided with its own attenuator (or in one or two cases, amplifier) to bring the level to the standard 1V. A single c.r. tube can then be switched to any test point. A check on the modulated waveform is obtained by rectifying the r.f. output of a probe in the output feeder.

Provision is made for measuring the voltage level at each test point and the signal amplitude can also be checked. This is done by measuring the shift voltage needed on the monitor to move the waveform across the tube. A d.c. amplifier is used in the monitor and the shift voltage is applied to its input so that changes in its gain do not affect the accuracy.

Reverting to the r.f. side, the feeder is not coupled directly to the tank circuit, for it is difficult to secure tight enough coupling while maintaining sufficient clearance to avoid flash-over. A tuned link circuit is interposed and enables the requisite coupling to be obtained more readily. It is also beneficial in permitting a better band-pass characteristic to be obtained and in assisting in harmonic suppression.

The feeder at this point is two-wire balanced and it is next converted to a coaxial form by a balance-to-unbalance transformer, or balun, which also gives some impedance transformation. This has the general form shown in Fig. 3, which is recognizable as a more-or-less normal balun except for the change of diameter of the inner conductor in the coaxial part. This is done to give an impedance transformation.

The feeder takes the signal to the vestigial-sideband filter. As shown in Fig. 4 it comprises complementary high- and low-pass filters. The latter takes the carrier and wanted sidebands and transmits them to the aerial feeder while the high-pass filter accepts the unwanted sidebands and transmits them to a water load where their power, some 2 kW, is dissipated. By using two complementary filters the input impedance is made substantially constant at all frequencies.

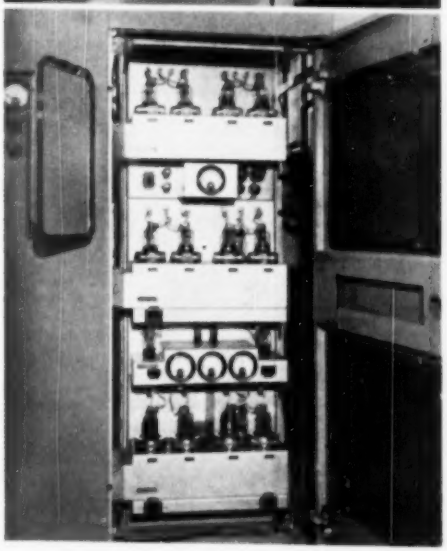
Final stage of the modulator (right) and front view (below) of output cathode-follower stage of the vision modulator with its four parallel valves.

If a single low-pass filter were used the power in the rejected sidebands would inevitably be reflected back into the output stage of the transmitter where it would affect its operation. The high-pass filter prevents this and enables the power of these unwanted sidebands to be harmlessly dissipated.

Physically, the filter is made up of lengths of coaxial feeder arranged as in Fig. 5. The stubs are spaced about $\lambda/4$ apart and the resonators are spaced from the main line some $\lambda/2$. All parts have the same outside diameters, but the diameter of the inner conductors varies to obtain the required characteristic. The "piping" is folded up for compactness.

The curve of Fig. 6 illustrates the filter performance. At 63.25 Mc/s, the frequency of the sound channel of a future television station, the response is down 12 db, but over the vision channel it ranges

The waveform monitor which can be switched to any test point in the transmitter circuit.



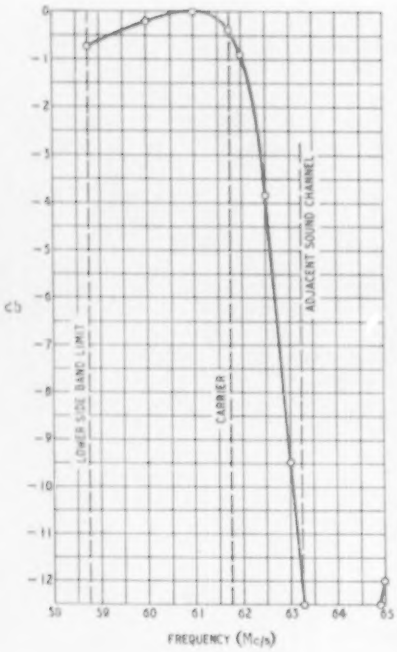


Fig. 6 (above).

Fig. 7 (below).

from 0.75 db at 59.25 Mc/s to −3.85 db at 62.5 Mc/s.

The water load for this filter is of a conventional type, since it must dissipate only a moderate amount of power. This cannot be said for the main water load to which the full transmitter output can be switched for testing and adjustment purposes. It comprises an outer cylindrical jacket with a close-fitting internal polythene cylinder. This cylinder has a very deep spiral slot cut in it, at the bottom of which is wound a copper conductor which connects to the inner of the coaxial feeder. The slot is filled with water which is pumped through it at about 10 gal/minute.

The arrangement is shown in Fig. 7 and its aim is to keep the stray capacitance low between parts other than earth. It does this because of the low dielectric constant of polythene relative to water; most of the electric field is in the water between the winding and the jacket and relatively little passes through the polythene between adjacent turns.

The high-voltage power supplies for the transmitter are obtained from a 415-V 3-phase supply through mercury-vapour rectifiers. The ripple frequency is relatively high with a 3-phase supply and this enables substantial economies in the smoothing equipment to be obtained. However, this is true only as long as the phases are balanced; any unbalance introduces a 50-c/s component which is passed by the smoothing circuits. In order to overcome this the voltages and phases of the supply are balanced by three moving-coil regulators.

Except in the output stage, the high-voltage supplies to the valves are all provided with valve stabilizers. The supply to the output stage is built out to constant impedance to avoid important impedance irregularities within the vision-frequency band.

All filaments, again with the exception of those of the output valves, are a.c. heated. A d.c. supply from a motor-generator is used for the output valves and this is electronically regulated to be within 0.1% of the nominal value.

The main contractors for the vision transmitter were E.M.I. The r.f. side was constructed by Metropolitan-Vickers under a sub-contract and the crystal-drive unit was supplied by Marconi's W.T. Company.

Fig. 6. Response curve of vestigial sideband filter.

Fig. 7. Inner element of main water load used for testing and adjustment.

The photograph shows part of the television modulator under test before being installed at Sutton Coldfield.

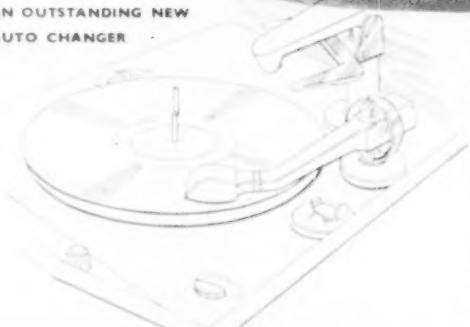
A superb H.M.V Autoradiogram

FOR THOSE WHO DEMAND THE BEST

"HIS MASTER'S VOICE"

The Hallmark of Quality

AN OUTSTANDING NEW AUTO CHANGER



To the radio enthusiast, to the music-lover, to people of critical discernment—to all those who want the best possible performance, this latest "His Master's Voice" achievement will make an immediate and irresistible appeal. It is an 8-valve automatic radiogram of up-to-the-minute design, embodying artistic and technical refinements which ensure a truly satisfying radio and record performance.

* 8-valve 5-waveband superhet receiver with extended tuning on short waves and variable selectivity.
* Separate wide-range tone controls for bass and treble.
* Very large (14½") elliptical loudspeaker with aluminium centre cone (an exclusive "His Master's Voice" design).
* Newly designed "His Master's Voice" fully automatic record changer, which, at the same time, allows single records to be played in the normal manner.
* High fidelity lightweight pick-up giving wide frequency response and minimum record and needle wear. Unique gimbal mounting.
* Normal extended range switch to ensure optimum results from all records.

WAVE RANGES : Models 5307/5402

S.4.	11.03– 14.29 metres	(27.2– 21.0 Mc/s)
S.3.	15.54– 20.98 metres	(19.3– 14.3 Mc/s)
S.2.	20.83– 32.97 metres	(14.4– 9.1 Mc/s)
S.1.	32.61–100 metres	(9.2– 3.0 Mc/s)
M.W.	187–575 metres	(1.604– 522 Kc/s)

H·M·V

THE GRAMOPHONE COMPANY LIMITED, HAYES, MIDDLESEX, ENGLAND

CONNOISSEUR PICK-UPS

Standard for steel and sapphire needles.
Fibre for miniature thorn or fibre needles.
Impedance 1300 ohms or 25 ohms.
Frequency Response 50-9000 c.p.s.
Super Lightweight pick-ups with interchangeable heads for standard or microgroove recordings.
All available with standard or transcription arms

2 SPEED GRAMOPHONE MOTORS

78 or 33⅓ r.p.m. at the turn of a switch.

Precision engineered for professional dubbing work. Low noise level

Bearings—Phosphor Bronze

Spindles hardened, ground and lapped.

Motor synchronous.

Connoisseur

offer

A COMPLETE RANGE OF HIGH FIDELITY EQUIPMENT

for

RECORDING AND REPRODUCING SOUND FROM DISCS

CONNOISSEUR RECORDING UNIT

Speeds 33⅓-78 r.p.m. at turn of a switch.

100-300 grooves per inch continuously variable.

Moving-coil Cutterhead of entirely new design, allowing use of large magnet system producing a sensitivity hitherto unobtainable. All patterning effects are entirely eliminated, allowing microgroove recordings to be made with ease.

Frequency Response. 30-15000 c.p.s.

ALSO AVAILABLE

High Quality Amplifiers. Single Speed Gramophone Motors (78 r.p.m.). Ribbon Microphone. Steel and Sapphire Needles. Cutting Stylii (Standard 78 r.p.m. or microgroove specification)

•

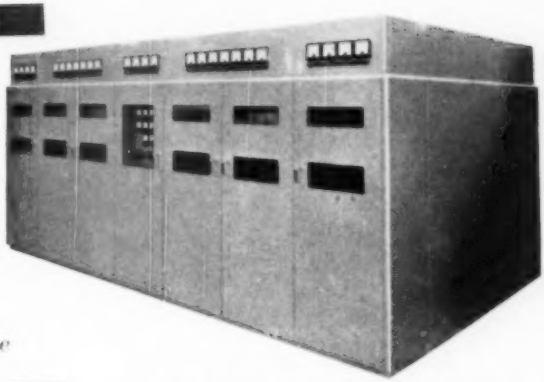
A. R. SUGDEN
& CO. (ENGINEERS) LTD.

BRIGHOUSE
YORKSHIRE
ENGLAND

35-kW TELEVISION

Sound Transmitter

12 kW at 58.25 Mc/s from a Single Earthed-grid Output Valve



General view of the Sutton Coldfield sound transmitter. From left to right the cubicles contain the earth switch unit, a.f. modulator circuits, early r.f. drive circuits, modulated driver stage, final modulated amplifier and harmonic filter. All doors are fitted with safety interlocks.

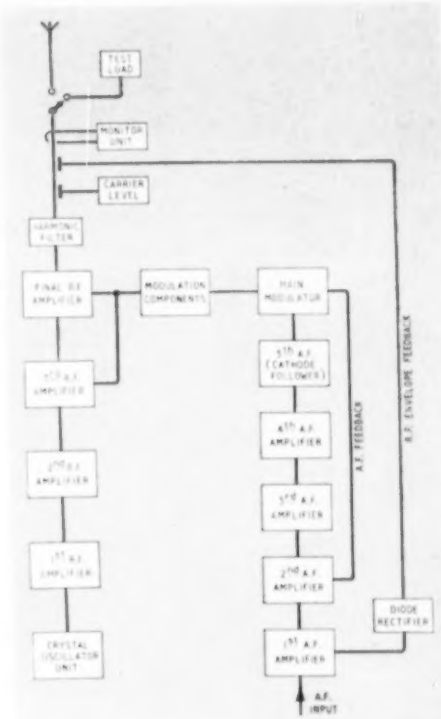
Data Summary

Output Power (unmodulated carrier).	12 kW to aerial feeder.
Frequency Range ...	40-67 Mc/s.
Modulation	High level Class "B."
Audio-frequency Harmonics (at 90% mod.)	60-7500c/s: 1.8%, 30-10,000 c/s: 2%.
Overall Frequency Response.	Level within 2db from 30-10,000 c/s.
R.F. Harmonics	Less than 200 mW radiated power.
Carrier Noise : ...	50db unweighted and 70 db weighted below 90% modulation.
Power Consumption ...	73 kVA at 60% modulation, including all auxiliaries.

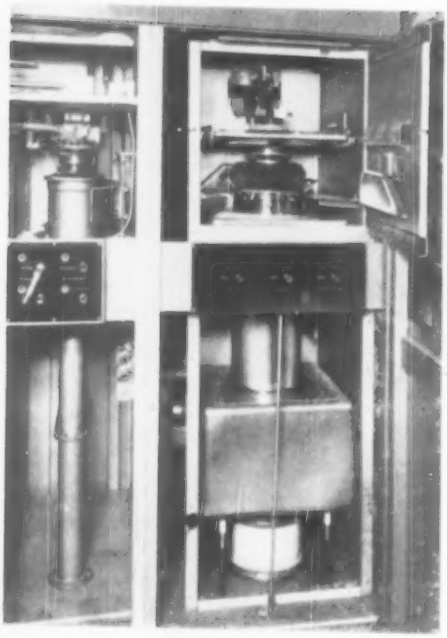
FOR its power the Marconi sound transmitter at Sutton Coldfield is a remarkably compact piece of equipment. One might almost describe it as a "packaged" transmitter, for after assembly and testing at the works at Chelmsford it was taken to Sutton Coldfield and installed without any extra constructional work on the site. No underground ducts are used in the installation and inter-unit connections and all auxiliary circuit wiring is prefabricated on perforated supporting channels of the type used on board ship. These are easily dismantled and are colour-coded for rapid identification.

The transmitter, covering a floor space of approximately 15ft by 9ft, is contained in cubicles arranged in line, and stands against one wall of an enclosure which houses the power conversion plant. Doors on the transmitter enclosure permit access to the apparatus, and these are so interlocked that they cannot be opened until all dangerous voltages have been removed and high-voltage terminals earthed. It is not possible to reconnect supplies until the doors have been properly closed and locked. The units and doors are substantially constructed, and some are fitted with toughened plate glass windows to allow observation of some parts of the circuit under running conditions. All essential adjustments can be effected from the front panels by mechanical drives.

All heavy oil-filled apparatus such as the modulation transformer, reactors, rectifier transformers, etc., are in the fireproof enclosure behind the wall of the



Block schematic diagram of the sound transmitter. H.T. to the third and final r.f. amplifiers is 8 amperes at 6,500 volts. All filament supplies are a.c. with the exception of that of the final amplifier.



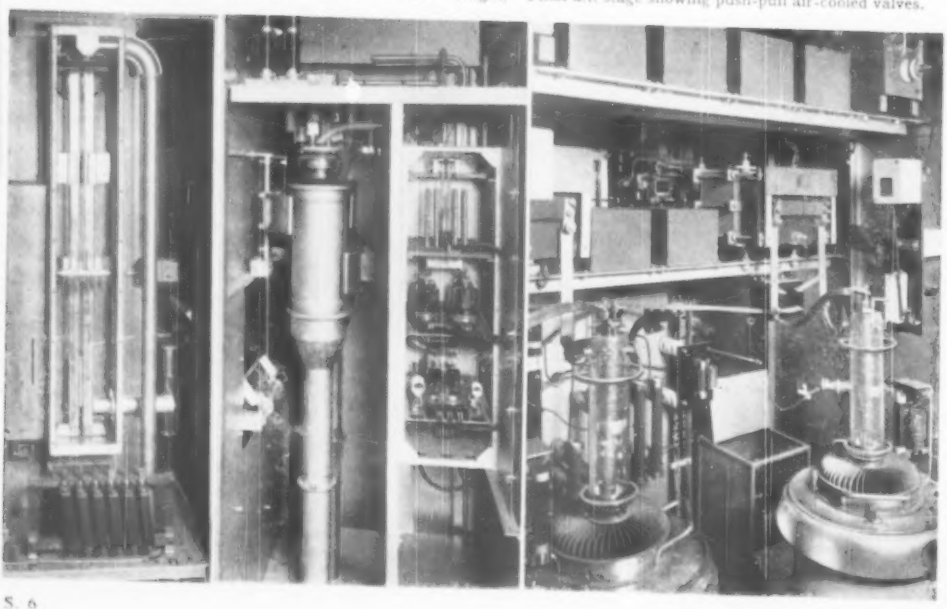
Type BR128 air-cooled valve," designed for use in earthed-grid circuits.

In the final amplifier (right of the photo on the left) the metal cubicle forms the outer member of a coaxial line circuit which is tuned by raising or lowering the box piston. The inner cylindrical conductor serves also as an air duct for cooling the valve anode.

main transmitter room, immediately adjacent to the transmitter itself.

Special crystal drives were designed by Marconi's for the Sutton Coldfield station and are used in the vision as well as the sound transmitter. The crystal is BT-cut, and has a low temperature coefficient. It is ground for a mean temperature worked out from a knowledge of its location in the chassis, and needs no temperature-control arrangements. It operates in a vacuum and is mounted in such a way as to be insensitive to external vibration. The three valves in the circuit are all twin tetrodes, type TT15. Half of the first valve is the crystal maintainer, while

Below (Left): Coaxial-line cathode circuit seen from the back of the final amplifier stage. The paired filament leads form the centre conductor and the outer conductor is the metal box, from which the cover has been removed. On the right are the coupling components from the driver stage, and in front of them the air line for cooling the filament and grid seals. (Centre) Penultimate push-pull modulated driver and to the right early r.f. amplifying stages. The coupling loop to the final amplifier is seen on the extreme left. (Right) Final a.f. stage showing push-pull air-cooled valves.



the second half is a doubler. The second TT15 acts as a push-pull trebler, so that the crystal operates at a sixth of the output frequency. The trebler is capacity-coupled into the third stage, which is a push-pull amplifier. The output is adjusted to match a balanced 80-ohm feeder.

A noteworthy feature of the oscillator is that the normal trebler stage can be changed to an LC oscillator which is adjustable over a limited range on both sides of the mean carrier frequency. This enables tests to be carried out on the r.f. response of the transmitter and aerial circuits, and is valuable in vision transmitters which have wide-band tuning and are of the type tuned asymmetrically for vestigial-sideband working.

Stabilized voltage supply circuits are built into the self-contained crystal drive unit, which measures overall only 20in × 12in × 15in.

Four stages of r.f. amplification follow the crystal drive with air-cooled valves throughout. Two TT12 valves in push-pull feed a second amplifier stage consisting of four TT16 tetrodes in parallel push-pull. This stage is in turn inductively coupled into the penultimate amplifier, which consists of two BR125 air-cooled triodes in a Class "C" circuit whose anode supply, in parallel with that of the final stage, passes through the modulator reactor. The final stage is a single-ended earthed-grid amplifier using a BR128 air-cooled triode.

Earthed-grid Amplifiers

The earthed-grid amplifier has many advantages in high-powered v.h.f. and u.h.f. circuits. It is inherently stable, and when there is negligible inductance within the grid structure of the valve itself the circuit does not require neutralizing condensers, the total minimum capacitance across the output tank circuit being thereby reduced.

Higher load resistances are possible and the power output which can be extracted for a given limiting dissipation in the valve is considerably increased. Further, the voltage applied to the cathode circuit is in series and in phase with the output of the anode, and the drive energy is added to the amplified output delivered to the aerial. To preserve linearity and to achieve high percentage modulations in circuits of this type, it is essential that the driver, as well as the amplifier, should be modulated.

The tuning arrangements for the various r.f. stages are controlled from the front of the panel to enable the operator to make fine adjustments in setting up the transmitter on frequency.

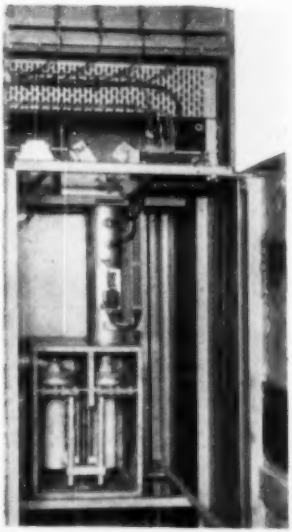
The audio-frequency amplifier consists of six stages and 14db of negative feedback is applied over the last four stages which terminate in a pair of ACT14 air-cooled triodes driven by four DET21 valves in a parallel push-pull cathode-follower circuit. Magnification is such that with a sinusoidal input signal of 4db above 1 mW into the input impedance of 600 ohms the carrier would be modulated to a depth of 40 per cent. Adjustment of the a.f. input level to the transmitter can be made over a range of 20db in ½db steps. A certain amount of r.f. is rectified and fed back into the input of the modulator as a device for reducing the overall noise and hum level.

All filaments in the transmitter and modulator, with the exception of those in the final r.f. amplifier, are a.c. heated, and the filament voltage is automatically maintained constant. The filaments of the final r.f. amplifier are heated by d.c. from a motor generator, the voltage from which is electronically controlled within limits of 0·5 per cent.

All the power conversion plant, with the exception of the main incoming switchgear and associated equipment providing the 415-V. 3-phase a.c. and 50-V d.c. was supplied by Marconi's Wireless Telegraph Company. It is complete with all necessary control gear, contactors, protective gear, isolating switches and fuses, power supply metering, etc., and this apparatus is located in a self-contained power distribution cubicle forming part of the power conversion plant enclosure.

The power conversion plant is remotely controlled from the transmitter control desk included with the equipment. The operator can carry out all the normal functions associated with starting up, control and closing down of the transmitter from this control desk, and adjacent to it is a mimic circuit with indicator lamps showing the functioning of all the transmitter and control circuit interlocks.

A water-cooled test load, simulating the aerial and capable of dissipating 18 kW continuously, is built in the transmitter enclosure, and can be switched into circuit when required. Modulation monitoring equipment is provided on the output feeder, and there is also a pick-up probe for a carrier level indicator.



R.F. harmonic filter with cover removed and coaxial feeder with carrier level, feedback and monitoring probes, leading to the aerial / artificial load changeover switch. At the top is seen a part of the prefabricated auxiliary wiring.

Specification for the Crystal Drive.

Output Frequency	Any specified frequency in range 40-72 Mc/s.
Stability of Carrier	± 5 parts in 100,000.
Output Power	5 watts.
Noise Level	More than 60db below 5 watts.
Harmonics	Less than 3% of carrier voltage.

The Diplexer

Feeding Sound and Vision Signals into One Aerial

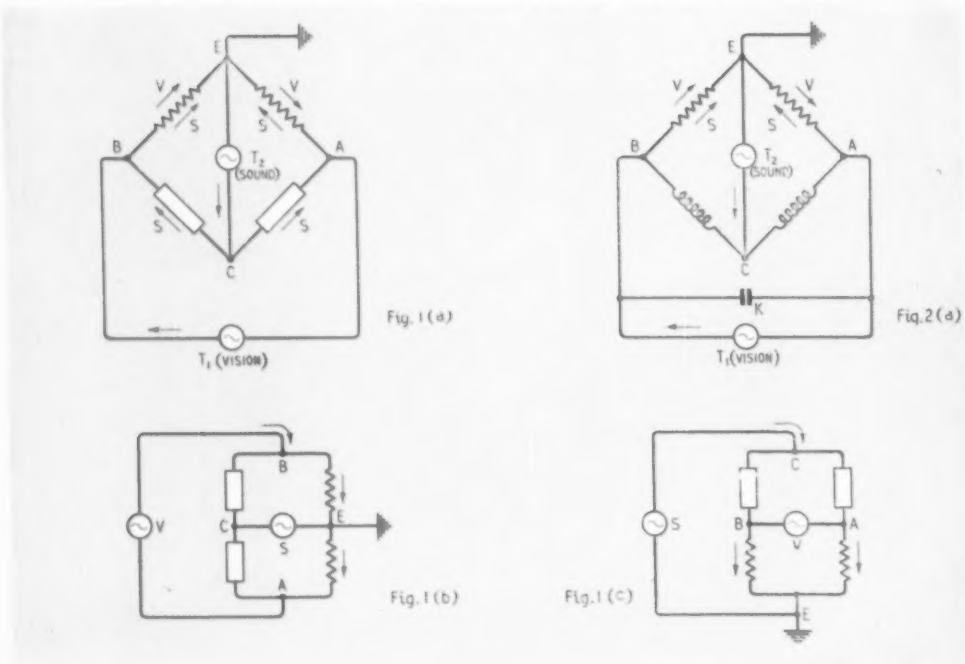
By C. GILLAM (*Marconi's Wireless Telegraph Company*)

SINCE only a single aerial system is used to radiate both vision and sound transmissions at Sutton Coldfield, it is necessary to have a special combining unit which enables this to be done with negligible interaction between the respective transmitters. The manner in which this is accomplished can best be understood by a preliminary consideration of the circuit arrangement shown in Fig. 1a.

Fig. 1a represents an application of the familiar Wheatstone Bridge; the two arms AE and BE are of identical resistance, and the two arms BC and AC are equal impedances. A generator T_1, corresponding to the vision transmitter, is connected across the diagonal BA of the bridge, and a second generator T_2 corresponding to the sound transmitter is connected across the diagonal EC. With the aforementioned equality of the adjacent arms, no vision voltage appears across the sound generator, and no sound voltage appears across the vision generator; thus no interaction can occur between the generators, and both can feed current to the four arms of the bridge independently. The useful loads, BE and AE, are connected in series as regards the vision generator. Thus, if their individual values are each R ohms their combined load on the vision generator is 2R ohms. The two impedance arms BC and AC also appear in series across the vision generator in parallel with the useful loads. It is therefore desirable for the branch BCA to have a high impedance compared with that of the branch BEA if there is to be no appreciable shunting effect on the latter. On the other hand, as seen from the sound generator, the useful

Fig. 1. (a) Bridge analogy for the operation of the combining unit re-arranged for better understanding in (b) and (c).

Fig. 2. (a) How bridge arm requirements may be met in a practical case with simplified version in (b).



loads BE and AE appear in parallel, in series with the impedance arms CB and CA. These latter arms should therefore present a low impedance to the sound generator in order that no appreciable voltage is dropped across them; and then the apparent resistance of the useful load to the sound generator is R/2. The manner in which the circuit appears to each generator is made clearer by redrawing Fig. 1a into the forms 1b, applying to the vision generator, and 1c applying to the sound generator. It is important to notice the difference in the directions of instantaneous current flow indicated by the arrows on the various diagrams.

Fig. 2 illustrates a method by which the requirements set out above for the arms BC and CA may be realized in practice. In this, the reactance of each inductance arm is low compared to the resistance in the arms BE and AE. Thus, only a relatively small impedance is presented to the flow of current from the sound generator. The capacitance K tunes the inductance branch BCA to resonance at the vision generator frequency, and thus a high impedance is offered to the vision signals which are, however, still free to flow in the arms BEA. Since there is no potential difference between terminals B and A due to the sound generator, capacitance K has no effect on the load circuit of this generator.

Fig. 2 is an accurate representation of the principle of the combining unit used at Sutton Coldfield, but several intermediate stages will require explanation before it will be clear how this circuit can be translated into an actual coaxial transmission line system.

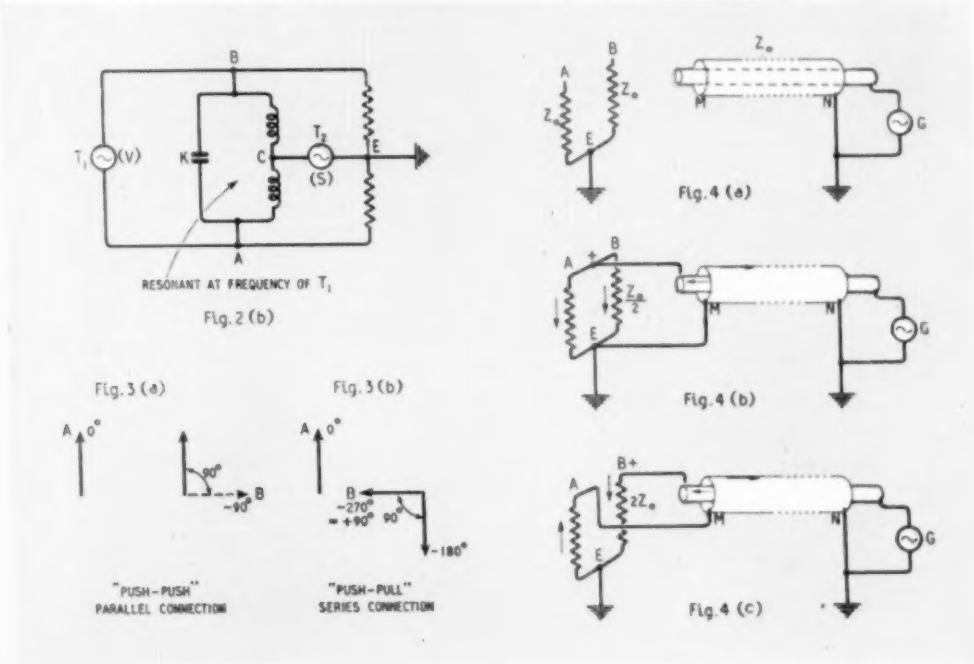
The Sutton Coldfield aerial consists of two identical systems of dipoles in perpendicular planes, which, in order to produce a horizontal radiation pattern approximating closely to a circle, require to be fed with exactly equal powers, but with a phase difference of 90° between them. This 90° phase difference is readily provided by making the length of the feeder system to one aerial plane 90° longer than the other, but apart from this the feeders to the two planes form a pair of loads which, for the purpose of this explanation, can be considered to be equal and purely resistive. They are, in fact, exactly analogous to the two resistances BE and AE of Fig. 1, in that they have a common earthed terminal, namely, the outer conductors of their transmission lines.

Feeding the Aerials

Radiation from the aerial is unaffected by whether this pair of loads is connected in parallel across a source or in series. The first method means that energy is fed to them in identical phase, or "push-push," and the second method feeds energy in "push-pull," i.e., with a 180° phase difference. For both methods, the effect of the extra 90° length of the feeder to one aerial plane ensures a 90° difference in the phase of radiation from the two planes. Reference to the vector diagrams of Fig. 3a and 3b makes this clear. It also brings out the fact that for the parallel connection (Fig. 3a) vector B lags vector

Fig. 3. Vector d'agrams for parallel and series connection of the loads presented to the transmitters.

Eig. 4. Resistance loads connected to a transmission line showing the actual point of earthing the system.



A by 90°, while for the series connection (Fig. 3b) vector B lags vector A by 270°, or what is in effect the same thing, leads vector A by 90°. The eventual result of this is that, in the rotating field system radiated by the aerials, the direction of rotation when the aerial feeders are fed in parallel is opposite to that resulting when the aerial feeders are fed in push-pull.

Now, let us consider Fig. 4a, which shows a pair of resistance loads, AE and BE, having a common earthed terminal E and a transmission line MN, of which the outer conductor is earthed. Energy is supplied to the transmission line by the source G. We can feed the two loads in parallel from the transmission line without difficulty by joining the two terminals A and B to the inner conductor of the transmission line, and the earthed terminal E to the outer conductor as shown in Fig. 4b. If the surge impedance of the transmission line is Z_0, and the resistance value of each load is equal to Z_0, the resistance of the two loads in parallel is $Z_0/2$, and this would represent a serious mis-match with a consequent standing wave on the transmission line. This can, however, be avoided by providing some form of impedance transformation, say by enlarging the diameter of the inner conductor of the transmission line for the last quarter-wavelength so that the surge impedance of this part is $Z_0/\sqrt{2}$. The input impedance of this last quarter-wavelength then becomes

$$\frac{2}{Z_0}\left(\frac{Z_0}{\sqrt{2}}\right)^2 = Z_0$$

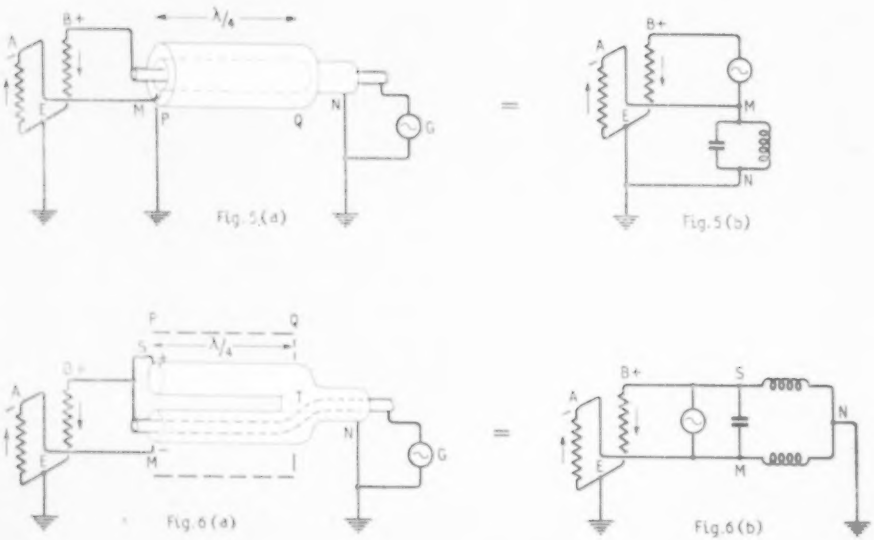
that is, the line will be matched on the generator side of the last quarter-wavelength.

If we wish to feed the two loads in push-pull, we can connect terminal B to the inner conductor of the transmission line, and terminal A to the outer conductor as in Fig. 4c. This puts them in series between inner and outer, but a difficulty at once appears in that the mid-point E is earthed. If the outer conductor of the transmission line is earthed at the point M, then resistance AE is completely short-circuited, and no power would be supplied to it. If, instead, the outer conductor is earthed at some other point N, then the resistance AE is shunted by the path MNE, which would not in general be a complete short-circuit, and some power would reach the load AE. If we could interpose a high impedance along the path MN, this shunting effect would be avoided, irrespective of the existence of the earth connections at E and N, and resistance AE would receive its fair share of the available power. In order to appreciate how this is possible, it must be understood that currents from the generator G flow into the transmission line only along the inner surface of the outer conductor, and correspondingly along the outer surface of the inner conductor. Thus an interruption in the current path along the outer surface of the outer conductor will not interfere with the supply of power from generator G to the loads AE and BE.

In Fig. 5a there is shown a cylinder PQ arranged coaxially with the transmission line MN. The length PQ is made an exact quarter-wavelength, and the cylinder is joined to the outer conductor of the transmission line at the end Q, while they are separated at the end P. We thus have a quarter-wavelength of transmission line formed by the inner surface of PQ and the outer surface of the outer conductor of line

Fig. 5. The shunting effect of the transmission line can be avoided by fitting an outer cylinder as shown at PQ.

Fig. 6. Adapting the arrangement of Fig. 5 to a wide-band system. The equivalent circuit is shown at (b).



MN and this line is short-circuited at the end Q, so that its input impedance has a very high value at the frequency in use. In fact, the cylinder PQ in conjunction with the outer surface of the transmission line MN behaves like a parallel resonant circuit. This high impedance appears in series between the points M and N, and so makes negligible the shunting effect of the branch MNE across the resistance AE. The equivalent circuit arrangement is shown in Fig. 5*b*.

Provided we have only a single frequency to transmit, there is no objection to the use of the arrangement illustrated in Fig. 5*a*. Television, however, requires the transmission of a wide band of frequencies, and it is at once apparent that as the transmission frequency deviates from that for which the cylinder PQ is an exact quarter-wavelength the input impedance of the short-circuited line becomes less and less, and there is an increasing shunting effect across resistance AE. Clearly power division between AE and EB will not be equal at frequencies off resonance.

Wide Band Characteristic

An obvious improvement is indicated by the arrangement of Fig. 6*a*. In this, the outer cylinder PQ is shown dotted, and there is now provided a "dummy" transmission line outer conductor ST, connected to terminal B of resistance BE. The conductor ST equally forms a short-circuited quarter-wavelength line in conjunction with the cylinder PQ, and hence at frequencies departing from resonance there would be identical shunting effects across AE and BE, which would ensure an equal power division. Further inspection shows that the two outer conductors MT and ST form of themselves a parallel wire transmission line, one quarter-wavelength long, and short-circuited at the end T where the main transmission line is branched in. This parallel wire system is shunted across the terminals A and B of the combined loads. It is then obvious that point T is a point of zero potential, since it is equi-distant from M and S which have equal but opposite potentials, and so there can be no potential difference between points T and N which could cause a current to flow along that part of the path shunting the resistors. This remains true even if the cylinder PQ is now removed, and power from the generator G would still be accurately divided between AE and BE, with points A and B preserving a true anti-phase relation over a wide frequency band. Nevertheless, the combined load AEB is shunted by the input impedance of the parallel wire transmission line MTS, and at frequencies departing from that for which MTS is resonant, this has the effect of changing the value of the terminal load of the line MN. Fig. 6*b* shows the equivalent circuit of the arrangement of Fig. 6*a*.

At this point, having demonstrated that a push-pull connection of the loads is practicable, it is as well to recall that the two loads then appear connected in series between the inner and outer conductors of the transmission line. If their individual resistances are equal to Z_0, the combined value is $2Z_0$, and again a matching arrangement is required on the transmission line MN. We can use the same type of impedance transformer as was proposed for the

Fig. 7. Schematic arrangement of the "split drum" method which is a simplified version of Fig. 6

Fig. 8. Final arrangement of the combining unit drawn as if the outer cylinder were transparent.

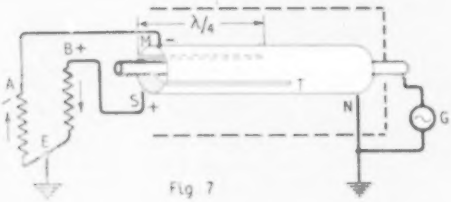


Fig. 7

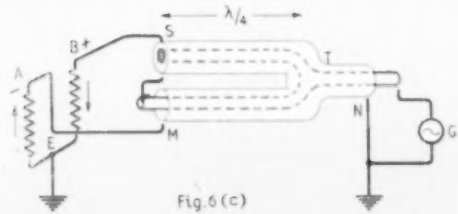


Fig. 6 (c)

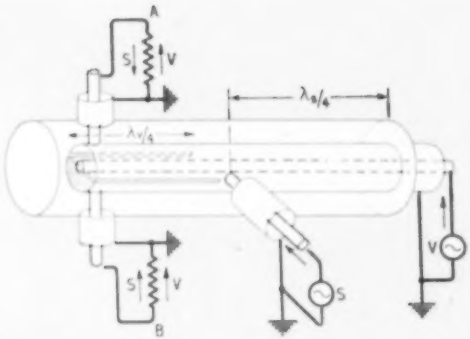


Fig. 8

parallel connected resistances, but this time the surge impedance of the quarter-wavelength section is required to be $\sqrt{2Z_0}$, which necessitates a reduction in diameter of the inner conductor.

A further step from Fig. 6*b* is shown in Fig. 6*c*. In this, we have put an inner conductor in the "dummy" branch line ST, joining this inner to that of the main transmission line at T, and short-circuiting it to its outer at S. Looking along the branch line TS from T, we have another quarter-wavelength short-circuited transmission line which of course has a high impedance at its resonance frequency and this is connected in shunt with the main transmission line at T. There is no effective change as regards the external connections from M and S to resistances AE and BE, but it may be appreciated that a high degree of mechanical symmetry is now possible in these connections, and this assists in the maintenance of exact electrical equality between the loads over a wide frequency range. The branch TS now performs an important function as a compensating "stub." As we have already seen, the parallel wire line MTS is shunted across the load AEB. At frequencies lower than that for which it is resonant, MTS behaves as an inductive reactance. At point T, a quarter-wavelength back along the line, this inductive reactance is transformed into a capacitive reactance. At this same frequency, however, branch TS has also become an inductive reactance, and by proper choice of its surge impedance, it is possible to arrange for this to cancel out the reactance due to the line MTS, and thus to maintain matched conditions on the generator side of the branch point. Similar effects, but with the signs of the reactances interchanged, occur at frequencies above resonance.

The Split Drum

We have now approached by easy stages to Fig. 7, which is a schematic of what is called a "split drum." This is very similar to the arrangement of Fig. 6*c*, but the independent transmission line branches MT and ST have been avoided by providing a pair of diametrically opposite longitudinal slots extending along the outer conductor of the main transmission line for a distance of a quarter-wavelength. The two halves of the outer conductor so formed still behave as a parallel wire transmission line, short circuited at the bottom of the slots; and since we arrange for them to have opposite potentials at their open ends, point T at the bottom of the slots has zero potential, and there is therefore no potential difference between this point and the earth connection at N to drive a current along the outer conductor from T to N. The separate inner conductors of the branches MT and ST of Fig. 6*c* merge into a single conductor in the arrangement of Fig. 7, and over one half of its circumference, this inner conductor is short-circuited to one part of the split outer conductor, corresponding to the short-circuit between inner and outer at S of Fig. 6*c*. The Fig. 7 arrangement behaves in almost all respects similarly to Fig. 6*c*. It is to be understood that the current along the inner conductor divides at the point T, part flowing into the short-circuited section, and the remainder continuing along the transmission line formed between the inner conductor and the other part of the split outer, and so flowing to the loads. It should also be clear that along this last quarter-wavelength of the line, the effective surge impedance between the inner and the half-outer is twice what there would be if the complete outer conductor were operative.

Split drums of the type shown in Fig. 7 can be enclosed in an outer cylinder if desired for screening or protection. The length of this cylinder, provided it is greater than the length of the slots, is unimportant and it does not enter into the balancing of the power to the loads. In this form, two split drums are used on the Sutton Coldfield aerial in order to provide binocular feeds to the dipoles from the single feed points of each aerial plane.

We can now look back on the diagram Fig. 1*a* and compare this with Figs. 6 and 7. It will be seen that the generator effective between the points M and S is equivalent to T_1 in Fig. 1 and that the "parallel wire line" MTS in Figs. 6 and 7 is equivalent to the Branch ACB in Fig. 1. Also MTS has a high impedance at the frequency of T_1, while it is clear that if we can connect T_2 between point T and earth, the branches TM and TS will present negligible impedance. All, in fact, that is needed to realize the combining unit is an arrangement to prevent energy applied between point T and earth flowing in the direction TN. A solution to a similar difficulty is provided by Fig. 5*a*, and we can adopt the same method, i.e., provide an outer cylinder one quarter-wavelength long at the sound transmitter frequency, extending toward the generator from point T.

The final arrangement of the combining unit is shown in Fig. 8, which is drawn as though the outer cylinder were transparent. This outer cylinder extends one quarter-wavelength at the sound frequency below the connection point of the sound transmission line. The outer conductor of the sound line is connected directly to the cylinder, and the inner conductor is connected to the split outer conductor of the vision line at a point immediately below the split. So far as the sound transmission is concerned, conditions are similar to Fig. 4*b*, and the loads are fed in parallel.

The last portion of the sound transmission line is formed by the split outer conductor of the vision line—both parts operating in parallel as an "inner"—and the outer cylinder, which operates as the "outer." The surge impedance of this portion can be arranged to perform the necessary impedance transformation. The length of the cylinder on the load side of the sound branch is not critical, and it is arranged to provide mechanical protection and screening for the internal parts. It plays only a very small part in connection with the vision transmission line.

This description of the method of operation of the combining unit has dealt only with the salient features of what is in fact a very complex piece of apparatus, and there are many aspects of its behaviour which it has not been possible to treat here. In the actual combining unit used at Sutton Coldfield, the impedance transformations are carried out in two stages, and additional compensating stubs are provided on both sound and vision transmission lines in order to maintain accurate impedance matches particularly over the wide vision frequency band.

It may be of interest to mention that this form of combining unit has other valuable applications. For example it has been used in high-power high-frequency transmitters to enable independent amplifiers to feed power into a common load.

"MICROPACK"

All Aluminium Construction

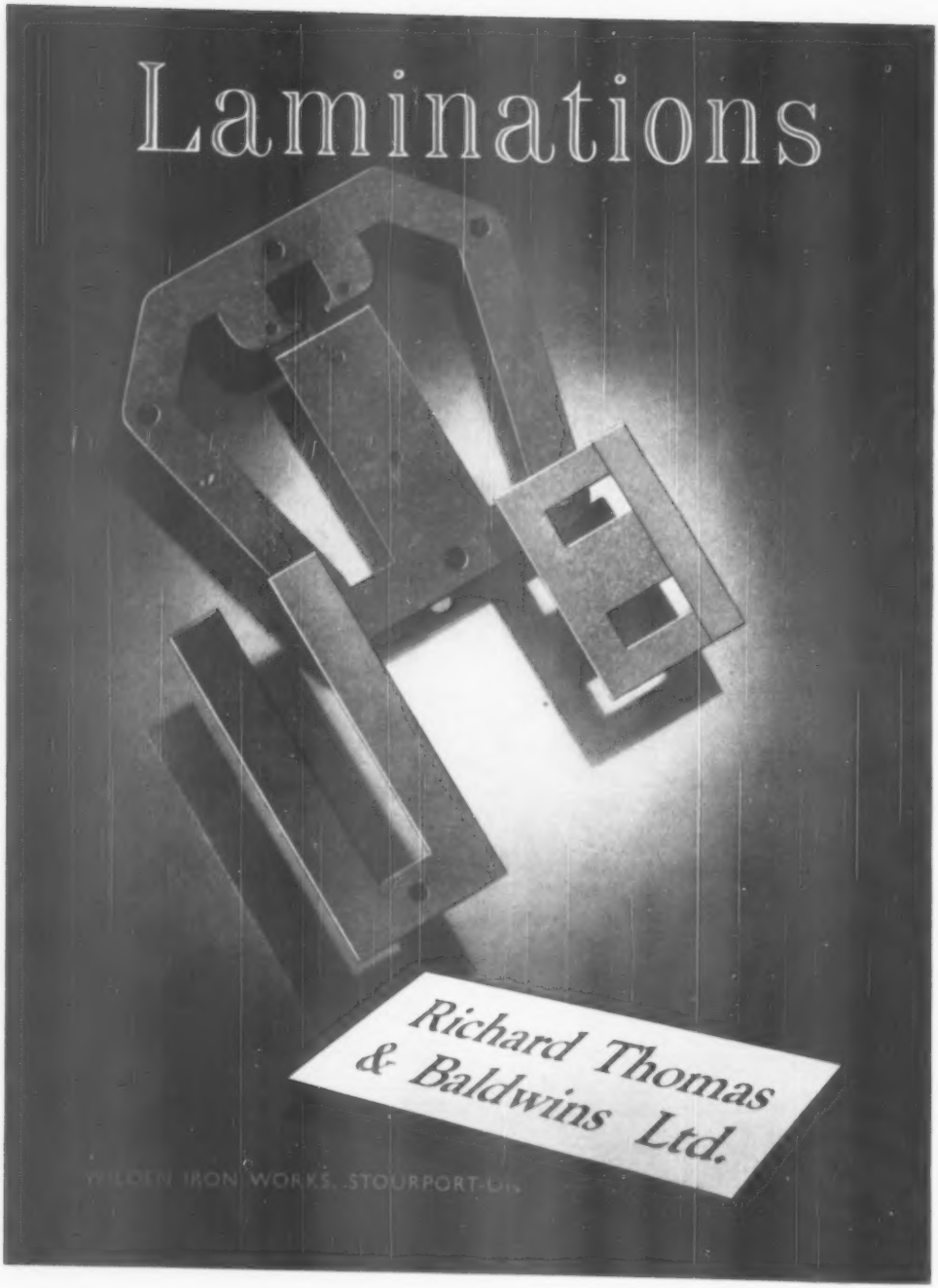
T.C.C. "Micropack" Electrolytics are the first choice of discriminating design engineers for all radio, television and electronic applications. They are hermetically sealed into aluminium tubes by means of synthetic rubber end discs and of "ALL ALUMINIUM" PLAIN FOIL CONSTRUCTION — fully tropical and compact. The exceptionally wide temperature performance permits of use at extremely low temperatures.

Stocked by all the leading distributors throughout the world.

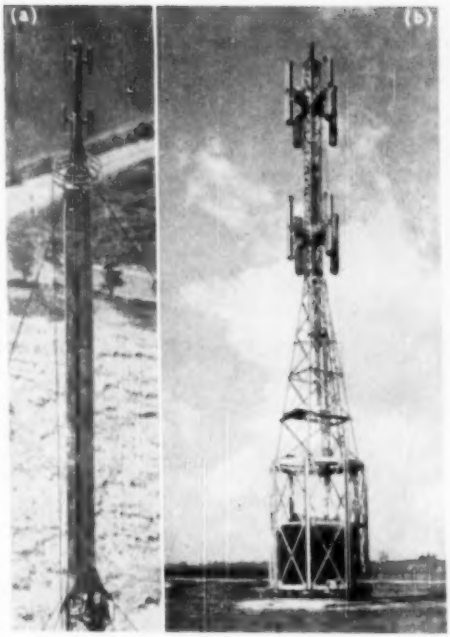
Cap. µF.	Peak Wkg. V	Dimensions	Type No.
100	6	1½" x ¾"	CE32A
25	12	1½" x ¾"	CE31B
50	25	1½" x ¾"	CE18C
12	50	1½" x ¾"	CE32D
32	150	2½" x 1"	CE19F
2	200	1½" x ¾"	CE31G
4	350	1½" x ¾"	CE18L
8	450	2½" x 1"	CE19P
4	500	2½" x 1"	CE13P

TCC

THE TELEGRAPH CONDENSER CO. LTD
RADIO DIVISION, NORTH ACTON, LONDON, W.3. ENGLAND


Laminations
Richard Thomas & Baldwins Ltd.
WILDEN IRON WORKS, STOURPORT-ON

One of the folded dipoles used in the aerial system. The only insulators are those for anchoring the outer ends of the folded dipole to which the twin feeders are connected.



(a) Immediately below the television aerial system is a slotted aerial section of mast which may eventually be used for a v.h.f. sound broadcast service.

(b) The "mock-up" of the Sutton Coldfield aerial used by Marconi's at Chelmsford for taking polar diagrams. The whole tower is rotatable.

Aerial System

Arrangement of Composite Radiator for Sound and Vision

THE aerial system for the Sutton Coldfield television transmitter was developed jointly by Marconi's Wireless Telegraph Company, and the British Broadcasting Corporation. It consists of eight folded vertical dipoles arranged in two tiers of four around a lattice steel top-mast at the summit of the aerial mast.

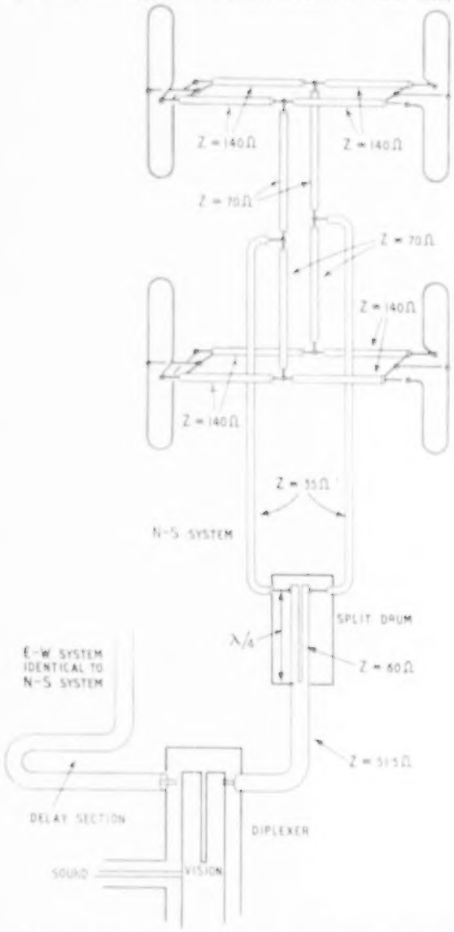
In accordance with the present British television policy, this aerial was designed for vertically polarized radiation, but it differs from the aerial of the London station at Alexandra Palace in that a single system radiates both sound and vision transmissions. The object of this is to give both transmissions the advantage of the maximum obtainable gain from a mechanical structure of a given height. Separate aerials to give the same gain on each transmission would have required a top-mast of about twice the height and the construction of this would have imposed serious mechanical problems which it would probably not have been possible to solve without excessive cost. Had an economic solution been possible, it would still have been desirable to combine the transmission and give both the benefit of the increased gain thereby obtainable.

The four dipoles of each tier are spaced at 90° intervals around a circle with a diameter of about 0.4 wavelength. The phase of the radiation from each dipole changes by ninety electrical degrees as one proceeds around the circle, thus, the phase of the radiation from diametrically opposite dipoles differs by 180°. This has the important effect of producing zero field strength along the vertical axis of the system where the supporting top-mast is located, so that not only are the losses in this top-mast reduced to a negligible amount, but also its cross-sectional dimensions are relatively unimportant. The quadrature phasing of the aerials contributes appreciably to the gain. In the two tiers of aerials, the radiation from vertical pairs is in phase.

Galvanized steel strip, 10in wide, is used for the construction of the dipoles, and 7½ kW heaters are built in and are used to prevent ice formation in cold weather. The radiators are directly bolted at their voltage nodes to lattice steel support arms built out from the top-mast. In this way no insulating material whatsoever is used in the mechanical structure of the aerial, and the only exposed insulators are those at the ends of the distribution feeders where these are connected to the radiators. The top-mast itself is of square cross-section and over a length of about 24ft 6in where it passes through the aerial system, it is parallel sided measuring 18in on the face. Below the parallel section, the top-mast is of pyramidal form, opening out to a side dimension of 4ft 6in where it is bolted to the top of the main structure.

Separate coaxial transmission lines are taken from each transmitter to a chamber at the top of the main mast structure, where the combining unit or "diplexer" is housed. The diplexer delivers com-

bined vision and sound signals to a pair of coaxial output lines, vision signals being oppositely phased in the two lines, while sound signals are similarly phased. The output lines then enter phase-splitting devices termed "split-drums" where the transmissions are again divided between further pairs of coaxials, with opposite phasing. An extra quarter-wavelength of transmission line is interposed between the output of the diplexer and one of the split-drums in order to provide a 90° phase delay. The four coaxials from the split-drums form two binocular pairs, one of which feeds the north-south vertical plane of dipoles, while the other feeds the east-west vertical plane. Each binocular pair rises to a point mid-way between the horizontal tiers where it is divided at a "tee" junction into vertical feeders supplying the upper and lower tiers; at each tier, there is a further sub-division into horizontal feeders which are connected to the dipoles.



Schematic diagram showing the feeder system of the Sutton Coldfield television aerial for one set of four dipoles. The four dipoles in the other vertical plane are fed from an identical feeder distribution system.

Full tests of the aerial system were carried out at the Marconi Company's Works at Chelmsford. The calculated horizontal radiation pattern was checked by rotating the complete aerial on a turn-table while the radiated field strength was observed at a fixed point. This procedure, rather than observing the field strength at a number of points in different directions at constant distance from the aerial, has the advantage of avoiding differences caused by variations in the transmission path or by reflections from local objects. For the purpose of some of these tests, the dipoles were mounted on a temporary top-mast of greater height than that eventually used at Sutton Coldfield.

The transmission lines from the transmitters to the mast head constitute no mean engineering achievement, the actual length of the double run being about 850ft. The lines have a characteristic impedance of about 51·5 ohms. They are made to strict dimensional limits from copper of 99·9 per cent purity, and they consist of outer tubes having an inside diameter of 5in with inner tubes having an outside diameter of 2·128in. The tubes are spaced apart by ⅛in diameter radial frequentite rods inserted in pockets in the inner tube set at 90° to each other.

Low Pressure Air Drying

The lines are constructed in 12ft lengths with brazed-on flanges; adjacent lengths are joined by bolting the flanges together, and these joints are made air-tight by rubber sealing rings let in grooves in the meeting faces of the flanges. The transmission lines are divided into sections of approximately 150ft, each section being provided with an air-tight expansion joint. Up the mast, an anchor point is provided at the bottom of each section, and this carries the weight of the section of line above it as far as the expansion joint below the next higher anchor point. Between the anchor points, the line is steadied by supports attached to each horizontal bracing member of the mast, but it is free to move longitudinally through these supports under the influence of temperature changes.

In order to prevent moisture entering the transmission lines and distribution feeder system, dry air at a low pressure is fed into them at the transmitter building, and it is allowed to escape from special bleeder holes at the extremities of the horizontal feeders adjacent to the dipoles.

The attenuation of the transmission line system is very small, accounting for a reduction in field strength of less than 6 per cent. Very great care was taken in matching the impedance of the various parts of the distribution feeder system, with the result that the reflection factor offered by the diplexer to the vision transmission line is less than 1 per cent over the whole of the frequency band of the vision transmission.

The upper part of the main support mast on which the television aerial is mounted is a cylindrical structure provided with slots in the outer surface. It is, in fact, identical to the aerial which has been erected at Wrotham, Kent, for sound broadcasting on frequencies of about 90 Mc/s, and the aerial at Sutton Coldfield could eventually be used for similar purposes. For the present, however, the necessary distribution feeder system and transmission lines are not being installed.

Mast Construction

Steel Lattice of Triangular Section and Cylindrical Slot Aerial

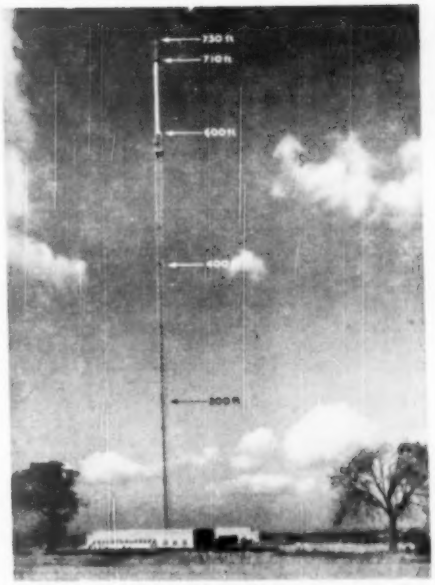


Fig. 1. General view of the complete mast, showing heights (except 750ft) at which guy ropes are attached.

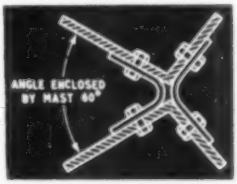
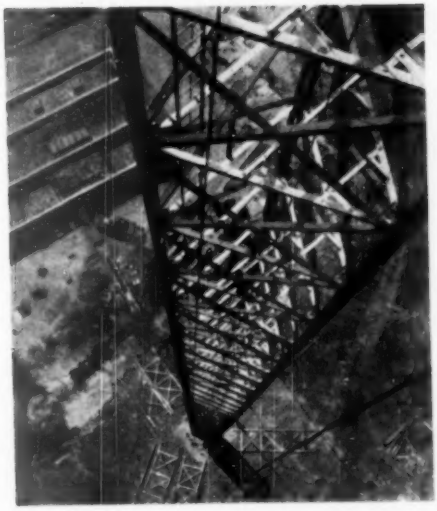


Fig. 2. Below is a view of the triangular lattice construction, with (right) detail showing section of the corner posts. On the ground can be seen a number of the flat panels before being hoisted up.



BY raising the combined sound and vision aerial array of the Sutton Coldfield television station to a height of some 1,300 feet above sea-level, this 750-ft mast has made television available to about six million people living within a 50-mile radius of Birmingham. It was designed to a general specification of the B.B.C. by British Insulated Callender's Construction Company, who were also the main contractors for the supply and erection of the structure and its ancillaries.

As will be seen from Fig. 1, the mast comprises three sections. A triangular lattice steel "support mast," 9ft across the face, extends from a pivoted base pedestal at ground level to a height of 600ft. Surmounting this is a cylindrical slot aerial structure, 6ft 6in in diameter and 110ft long, containing 32 vertical slots, each 8ft long by 1ft wide. This slot aerial is not for immediate use, but is available for future e.h.f. sound broadcasting purposes. At a height of 710ft the top-most guys are attached, and above these, standing as a cantilever, is a short square tower carrying eight dipole aerials and reaching, with its warning light and lightning conductor, to a height of 750ft.

The support mast was made triangular in section, rather than square, because a three-cornered structure not only leads to economy in materials, but is also rather quicker and easier to erect. A drawback of this type of construction, however, is the somewhat restricted internal space available for the lift and other purposes. The main columns or corner posts, which are parallel, are of high-tensile steel, and are built up of two angle-sections bolted together corner to corner. This construction can be seen in the inset to Fig. 2. It was found that the use of high-tensile steel not only lowered the overall cost of the structure, but the smaller scantlings required led to an appreciable reduction in the total area of steelwork presented to the wind, and thus in the wind loading to be provided for. The steelwork was assembled on the ground in flat panels, which were hoisted into position face by face by means of a floating derrick, all connections being bolted.

The slot aerial cylinder is formed by a thin skin of mild steel plate, with suitable internal stiffeners and jointing flanges, and is sectionalized in quadrants 10ft 6in high each containing one slot, to simplify

erection. An interesting detail is the junction of the cylindrical slot aerial structure with the triangular support mast; the arrangement at this point, which is a neat example of the boiler-maker's art, is clearly shown in Fig. 5. As will be seen from Fig. 4, which shows a view looking downwards from the top of the slot aerial, the apertures are provided with "Perspex" covers; these are considered desirable, both to protect the future e.h.f. distribution system from the weather and to prevent the formation of violent wind eddies inside the structure.

The "all up" weight of the mast is some 140 tons, whilst the maximum thrust on the base pedestal, including the vertical components of the guy tension, is 336 tons. As can be seen from Fig. 5, the base of the mast is pivoted on the pedestal, and the central locating point of the pivot is formed by a steel ball of 2in diameter.

Arrangement of Guy Ropes

All the structural steelwork, which was manufactured by Horseley Bridge and Thomas Piggot, Ltd., has been hot-dip galvanized after fabrication, giving a zinc coating of about 2oz per square foot of surface. This is perhaps the most effective commercial method of guarding structural steelwork against corrosion and should eliminate the need for maintenance painting for many years. Some colour painting may be necessary, however, to meet the requirements of the Ministry of Civil Aviation for obstruction marking.

Support is provided by guy ropes spaced 120° apart in plan, and attached at heights of 200ft, 400ft, 600ft and 710ft. These ropes are of Wrights Ropes' fully locked coil construction in 110/120-ton quality steel, and range in circumference from 4¾in to 6in; absence of inelastic stretching is one of their important advantages. The guys are made-off at each end by solid steel conical sockets, in which the broomed out rope ends are embedded with white metal. In accordance with the B.B.C.'s specification, all ropes have a factor of safety of four on the breaking load under the most severe conditions, the latter including a coating of ice of ½-in radial thickness, simultaneously with a wind pressure approaching 60lb per square foot at the mast head. At the anchorages, provision is made for rigging the guys to tensions which have been calculated for still air conditions. These rigging tensions are separately computed for each set of guys so that at each point of attachment the possible horizontal deflection of the mast is proportional to the height above the base pivot. Consequently, the points of attachment remain in a straight line, and the mast can be treated as a simple continuous beam with linear supports. In this way, secondary stresses arising from relative movement of the supports are avoided. The maximum deflection at any point was limited by the specification to 1% of its height above ground, so that a movement of 7ft 6in from the perpendicular at the mast head is envisaged under the most severe conditions.

A small two-man electric lift has been installed in the support mast and operates from a platform near the base to a point close to the foot of the slot aerial. The heavy unbalanced loads which would arise from the weight of the hoist ropes when the car and the balance weight are near the end of their travel, have been avoided by fitting a compensating rope on the underside of each which passes round a loaded jockey wheel at the mast base. Normal push-button controls were precluded by the difficulty of dealing with hanging cables in an open structure of this kind, and the car is therefore controlled from a ground station. It is, however, possible for the occupants to stop the car at an intermediate platform by operating a ramp which, when extended, throws a switch mounted on the mast structure. The lift motor, which is of conventional design, is mounted in a weather-proof housing at the 600ft level and is arranged to operate the lift at 100ft per minute. In addition to the mast telephone circuits, communication with the ground station can be maintained by means of walkie-talkie radio apparatus carried in the car.

To ascend the slot aerial it is necessary to leave the lift and use the cat ladder, which runs from ground level to the octagonal platform at the base of the top-mast. Ascent of the top-mast itself is made by means of step bolts.

Fig. 3. The slot aerial viewed from a height of 700ft. A distorted reflection of the roof of the transmitter building can be seen in the "Perspex" cover of the uppermost slot. Fig. 4. Platework at the junction of the cylindrical slot aerial with the triangular support mast. Guy rope attachments at the 600ft level can also be seen. Fig. 5. The 2-in diameter steel ball being placed in position before the first section of the support mast is lowered on to the base pedestal.

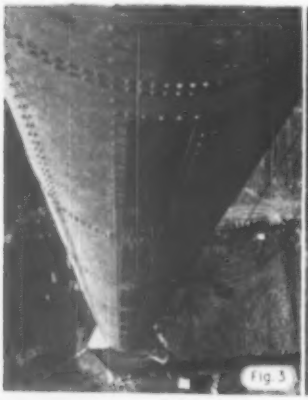


Fig. 3

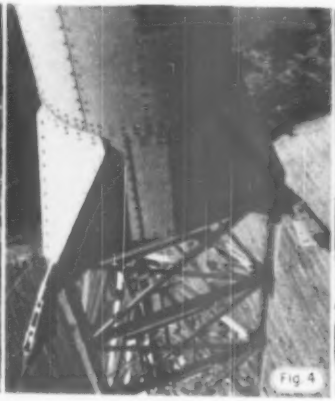


Fig. 4

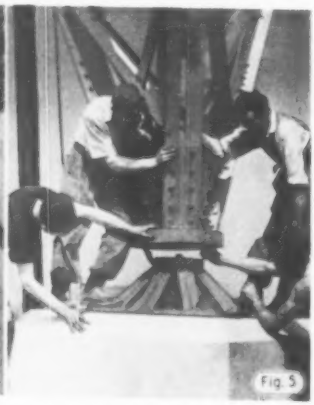
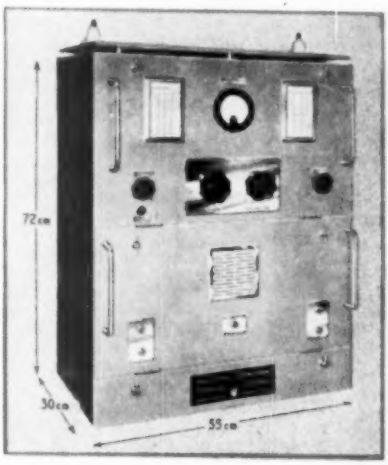


Fig. 5

Radio Communication Network

Project for Ship-Shore Radio-telephone Service on Lake Nyasa



Radiotelephone transmitter-receiver (Type IMR. 43/36) which is being installed for the Nyasaland Railways communication network by the International Marine Radio Co. This is the 25-watt equipment.

The seven coast stations, including the headquarters of the lake service at Monkey Bay, and the railway headquarters station at Limbe are indicated on this map of Lake Nyasa

THE provision of a network of stations around the shores of Lake Nyasa for the maintenance of radiotelephone and radiotelegraph communication between the ports and ships plying on the lake has been entrusted by the Nyasaland Railways to the International Marine Radio Company of Croydon. Not only is it necessary in this scheme to ensure satisfactory communication between ports and ships, and of course *vice versa*, but also between ports. The distance between the ports at the extremities of the lake is some 320 miles. In addition the lake headquarters station at Monkey Bay has to maintain communication with the railway headquarters at Limbe, a further 120 miles south.

The configuration of the lake lends itself admirably to a directional aerial system at each shore radio station, but at the same time, it is essential to keep the whole equipment, including aerial systems, simple from the point of view of maintenance. Bearing this in mind it has been decided to use a transmitting aerial of the folded terminated dipole type, with wideband frequency characteristics, at each shore station. It is considered that this type of aerial will provide the necessary directional properties in a north-south line whilst still maintaining an adequate field strength in the east-west line for communication with ships and also with stations on the opposite side of the lake. A separate aerial of the orthodox vertical type will be employed at each shore station for reception.

The aerials for the ships are somewhat more problematic, as highly directional systems are generally unsuitable for installation aboard small vessels and their effectiveness would depend largely upon the geographical position of the vessel at any given time. It has therefore been decided to utilize the usual single vertical wire type. This will, however, be subject to reconsideration during initial tests.

Design of the transmitting and receiving equipment was mainly governed by two factors—simplicity of operation and available power supply. The only stations at which an a.c. mains supply is available are Monkey Bay and Limbe. All other stations, including the ships' transmitters, have to operate from batteries.

The transmitters at Limbe, Monkey Bay and Mwaya will deliver 75 watts to the aerial whilst all other stations, including the ships', will have a power of approximately 25 watts. When left unattended a selective calling device indicates when a particular station is being called.

Both types of equipment, which are tropicalized and modified versions of sets installed in coasters and trawlers, incorporate similar basic circuits, but the 75-watt transmitters employ voice-operated carrier control in addition to the normal press-to-talk facility. Crystal-controlled frequencies up to a maximum of ten are available on both transmitters and receivers, but at present only five frequencies between 3 and 7 Mc/s have been allocated to the Lake Nyasa service.

Improved Navigational Aid

Positive Lane Identification for Decca Navigator

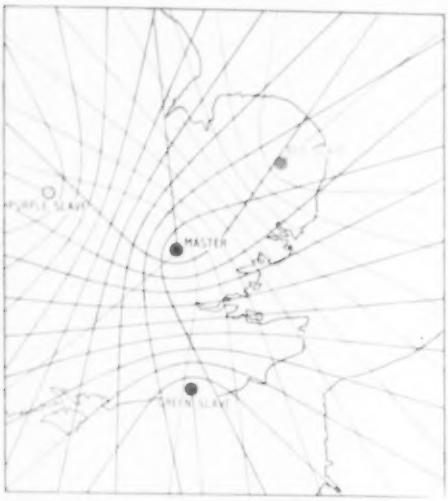


Fig. 1. English Decca Navigation chain. The Red, Green and Purple phase-patterns have been divided up into zones, as all the Decca lanes cannot be drawn in.

Fig. 2. Lane identification meter, showing the sector pointer (controlled by the coarse phase-meter) and the six-arm vernier pointer (controlled by the intermediate phase-meter). The Red, Green and Purple scales, each representing one zone on the chart above, have different groups of lane numbers to avoid possible confusion.

RED ZONE = 24 LANES (1-24 ON SCALE)
GREEN ZONE = 18 LANES (20-48 ON SCALE)
PURPLE ZONE = 30 LANES (50-80 ON SCALE)

BEFORE explaining the purpose and operation of lane identification, it will be necessary to make a brief survey of the basic Decca Navigator system. This is a hyperbolic navigational aid, in which geographical position lines are established by the phase relationships of waves radiated from a group of c.w. transmitters. Fig. 1 shows the general layout of the three families of hyperbolic position lines (designated Red, Green and Purple) which are set up by the English chain of stations. Taking the Red phase-pattern as an example, and assuming for the moment that both the Master station and Red Slave station are radiating the same frequency and are locked in phase, then each hyperbola is a locus of all the points at which the two sets of waves arrive with constant phase difference.

Obviously it would be possible to draw an infinite number of these hyperbolæ, each representing a particular value of phase difference, until the map was completely blacked in. On a Decca navigational chart, however, the hyperbolæ are drawn only at positions where the maxima and minima of the two sets of waves coincide (to talk about "in-phase positions" would be confusing here), which means that the hyperbolæ are spaced apart by one cycle (or 360 deg) of phase difference. Note that since both sets of waves are travelling outwards and intersecting each other, the spacing occurs at every *half*-wavelength of the comparison frequency. Plainly, then, the number of hyperbolæ spaced in such a manner between the Master and Slave is directly proportional to the frequency concerned.

The areas between adjacent hyperbolæ are known as Decca "lanes," and are identified by numbers. Unfortunately, it has not been possible to show all of them on Fig. 1, and a hyperbola is drawn only at every 24 Red lanes. The areas between these widely spaced hyperbolæ are, in fact, known as Decca "zones," and are identified alphabetically. Similarly for the Green phase-pattern, where each zone shown actually represents 18 lanes, and for the Purple phase-pattern, where each zone represents 30 lanes.

It is worth noting here that the zonal patterns themselves (Fig. 1) are such as would be set up by a phase comparison frequency of 14.2 kc/s transmitted from all four stations. This can be regarded as the fundamental frequency of the Decca system, and henceforward will be referred to as f. The phase comparison frequency of the complete Red pattern is actually $24f$, from which it can be seen why there are 24 lanes to a Red zone. Similarly, the phase comparison frequency of the Green pattern is $18f$, and that of the Purple pattern is $30f$.

In practice it is not possible for both stations creating a pattern (Master and Slave) to radiate the same frequency, i.e., the phase comparison frequency, since in the Decca receiver there would be no way of separating the two signals for the purpose of measuring their phase difference. The actual frequencies radiated are different, as shown in

Fig. 3. Normal working. At (a) is shown the distribution of frequencies in the transmitting chain, and at (b) a block diagram of the final stages of a Decca receiver, after the various incoming frequencies have been separated out.

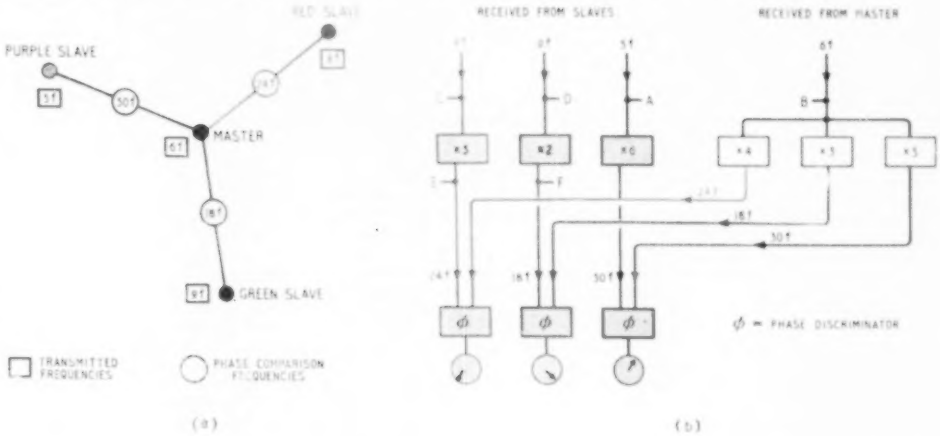


Fig. 3 (a), but it will be seen that in each case the phase comparison frequency is a harmonic of both the Master frequency and the particular Slave frequency. For instance, the Red comparison frequency $24f$ is the 4th harmonic of the Master ($6f$) and the 3rd harmonic of the Red Slave ($8f$).

The function of the Decca receiver in the ship is to detect and measure phase differences and thereby to indicate on which of the hyperbolic position lines it is situated. After the individual transmissions are separated in the receiver, the necessary harmonic—or phase comparison—frequencies are derived from them by multiplying circuits, as shown in Fig. 3 (b). In effect, then, the Red phase discriminator "sees" a phase-pattern such as would be set up by $24f$ transmissions from the Master and Red Slave, although no such frequency is actually radiated. It finds the phase difference between the two incoming $24f$ signals, and the corresponding hyperbola is then indicated on the phase meter or "decometer" in terms of zones and lanes. To obtain a navigational fix, of course, requires at least two position lines (say one from the Red pattern and one from the Green pattern) and the ship will be at their point of intersection on the chart.

One of the main drawbacks of the basic system described above was the requirement that a voyage should commence from a known position within the coverage of the stations. The decometers were set at this known position, and all their subsequent

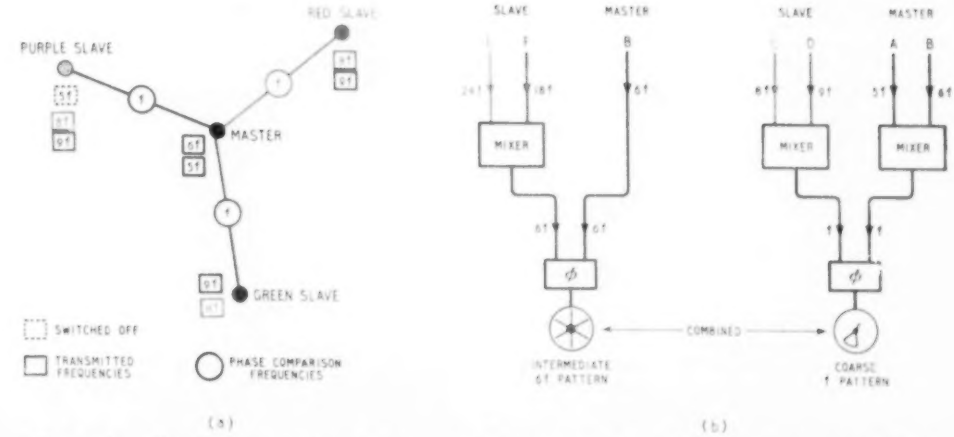


Fig. 4. Lane identification. At (a) the re-grouping of frequencies in the transmitting chain, and at (b) the receiver arrangement, showing the additional circuits which are connected to the points marked A to F in Fig. 3 (b).

readings depended on a process of continuous integration of the phase differences resulting from the movement of the ship away from the known position. When a ship entered the Decca coverage from outside, without accurate knowledge of its position, there was no way of initially setting the decometers; and the same difficulty arose within the coverage if the Decca receiver had been out of operation for a while. To meet such contingencies, an automatic system of "lane identification" was developed, and has now been in operation for more than a year. This system finds the position of the ship by an independent process, given certain minimum information, and indicates on a direct-reading meter the Decca lane numbers to which the decometers should be set. The "minimum information" required is the Decca zones in which the ship is situated, but since most Decca zones are fairly broad areas (roughly 12 deg azimuth), this information is usually quite readily available.

Additional Phase-patterns

The independent process of position-finding, by which lane identification is achieved, consists of superimposing a coarser phase-pattern on each of the normal Red, Green and Purple patterns in turn, and indicating the position of the ship relative to this coarser pattern by an associated "coarse" phase meter. The actual coarse patterns employed (one for each colour) are identical to the zonal ones shown in Fig. 1 which, as mentioned above, correspond to a phase comparison frequency of f. As the ship moves from one of these superimposed hyperbola to the next, the pointer of the coarse phase meter revolves once, thereby indicating one zone. Now a Red zone consists of 24 lanes, so the dial of the coarse phase meter is calibrated accordingly; thus, when the pointer of the meter takes up a position round the dial corresponding to the position of the ship in a Red zone, it also identifies a Red lane number. Similarly when the coarse patterns are superimposed on the normal Green and Purple patterns, additional scales of 18 Green lanes and 30 Purple lanes respectively being provided on the meter. The general appearance of the coarse phase meter—or lane identification meter—is shown in Fig. 2, and the pointer so far mentioned is the one formed into the shape of a section.

Thus, in the case of a ship entering the coverage from outside, as soon as the Decca receiver is switched on, the lane identification meter will begin to indicate Red, Green and Purple lane numbers in turn. This enables the decometers to be set to the correct lane numbers, but not to the correct zones. (Indicated lane numbers do not help to identify zones, because on the Decca navigational chart the same sequence of lane numbers is repeated in every zone, as will be seen from Fig. 2.) It is therefore necessary, as mentioned above, for the approximate zonal position of the ship to be found by other methods, in order to make sense of the lane identification readings.

In practice, it was found that under some conditions the pointer of the lane identification meter did not indicate the lane number with sufficient steadiness, so it was decided to employ in addition an intermediate pattern, with an associated phase meter, to act as a vernier on each of the coarse patterns. This intermediate pattern corresponds to a phase comparison frequency of $6f$, which means that it divides each zone into six equal parts. The "intermediate" phase meter therefore makes six revolutions as the ship moves across one zone, but to enable it to indicate on the same set of scales as the coarse phase meter, it is geared down six times. Furthermore, since a reading by the intermediate phase meter could refer to any one of the six equal parts of a zone, the six possible indications must be given simultaneously by the pointer. This is achieved by the six-arm pointer shown in Fig. 2, the correct arm for a particular reading being embraced by the coarse sector pointer.

To establish the coarse and intermediate patterns would, in the normal way, require a second group of c.w. transmitters and additional frequency channels in the Decca receiver. A way of avoiding this embarrassment, however, is offered by the fact that there is no need for continuous lane identification on all three patterns simultaneously. In fact, the existing frequencies are "borrowed," but for such short intervals that the normal working remains unaffected. Lane identification is therefore performed on each of the three patterns in turn by switching off the normal arrangement for half a second and re-grouping the frequencies to produce the f and $6f$ patterns during this period.

Referring to Fig. 4 (a), which shows at once the re-grouping arrangements for all the patterns, the sequence of events is as follows:—

8.00. (Red lane identification), the normal system is switched off except for the Master, which radiates the additional frequency $3f$, and the Red Slave, which radiates the additional frequency $9f$. After half a second the normal system is restored.

8.01. (Green lane identification), the normal system is switched off except for the Master, which radiates the additional $5f$, and the Green Slave, which radiates the additional $8f$. After half a second the normal system is restored.

8.02. (Purple lane identification), in a similar manner. Then follows a gap of three minutes, and the sequence commences again at 8.05.

Re-grouping in the Receiver

The onset of each re-grouping is signalled to the Decca receiver by a change of 100 c/s in the frequency of the Master, $6f$, lasting for 1/25th of a second. This operates a relay, which connects the additional circuits shown in Fig. 4 (b) to the points marked A-F in the normal receiver circuit, Fig. 3 (b), and also lights up the appropriate scale on the lane identification meter. At the end of each lane identification these additional circuits are disconnected and the receiver is restored to normal.

It will be seen from Fig. 4 (b) that the phase comparison frequencies of the coarse and intermediate patterns, f and $6f$, are beat frequencies derived from the mixers; no heterodyning takes place at the transmitting end. In effect, then, the coarse phase-discriminator "sees," at each lane identification in turn, a phase-pattern such as would be set up by f transmissions from the Master and the appropriate Slave, although no such frequency is actually radiated. It finds the phase difference between the two incoming f signals and passes the resultant to the coarse phase meter. Similarly for the intermediate phase discriminator, which "sees" a phase-pattern such as would be set up by $6f$ transmissions.

Nation-Wide Television

Choice Between High Power and Low Power Transmitters

By R. W. HALLOWS, M.A.(Cantab.), M.I.E.E.

AT the present time the governments of most of the world's civilized countries are giving some attention to the question of providing a television service for their citizens. In some countries such a service is already partly in being, and it is necessary to consider the best methods of completing it; others have determined to make an early start on the foundations of what will, if all goes well, become a nation-wide service; others, again, realize that, though there is no immediate prospect of inaugurating even the most modest of television services, it is something which will have to be done eventually. Into whichever category a country falls to-day, those responsible for what we may call its electronic development must be always ready to learn all they can from what has been accomplished in other lands in such departments as telecommunications, broadcasting and television.

Only three countries have so far been able to establish any kind of regular television service: Britain, France and the United States of America. The British service, dating back to 1936 for high-definition transmissions and to several years earlier for the original 30-line Baird system, used by the B.B.C. for broadcasts on the medium-wave bands, has by far the longest history. Like Britain, France had also a pre-war service. This was conducted from the present Eiffel Tower station. In their efforts to recover from the effects of a second world war Britain and France—especially France—had to concentrate all available money and manpower upon essentials. Television, being a luxury rather than a necessity, had to be relegated to a place a long way down in the queue, with the result that Britain has only recently got her second transmitter to work, whilst development in France is considerably less advanced.

For all the strenuous and noble part she played in the war, America sustained no destruction of homes or factories and no major financial blows. She was thus in a position, once the war was ended, to push on with the rapid development of a national television scheme. In America there are to-day more than a hundred television transmitters and well over a million televisors.

When, however, we come to examine the position in Britain and America a little more closely the differences in the results achieved are by no means so great as might appear at first sight. The hundred American stations bring not more than 50 per cent of American homes into television service areas—by service area is meant the region in which good reception is assured at all times under normal conditions. Britain has only two transmitters in operation, but some 40 per cent of all her homes are in the service areas of these.

Within two years from now 80 per cent of the homes of the United States will be brought into television range. In Britain *tempo* is necessarily slower, and it will be almost five years before the same percentage is reached. But it will be achieved by entirely different methods and this is a matter of interest to all of those in other countries who are concerned with the inception and development of television services.

To obtain her 80 per cent television coverage America will bring the total of her television transmitters to between 300 and 400: Britain will accomplish the same purpose with only ten transmitters. The essential difference between the two schemes is that the American is based upon a large number of low-powered transmitters rated, with few exceptions, at between 0.5 and 5 kilowatts, whilst the British envisage the use of a small number of high-powered installations. The present intention is that, of the ten British stations, five will be rated at 35-40 kilowatts and five at 12-15 kilowatts.

In fairness to the American system it should be added that with 300-400 stations a considerable number of viewers will have a choice of two or more programmes. Probably a number of stations not greater than 200, rated at 0.5-5 kW, would suffice to provide 80 per cent coverage with a single programme. It must also be borne in mind that distances are much greater in the United States and large areas of densely populated country much rarer than in Britain.

Range of Television Wavelengths

Be that as it may, the fact remains that there are now two fundamentally different systems of nation-wide television broadcasting on their way to completion. It is therefore to be expected that authorities in other countries will carefully examine the advantages and the drawbacks of each before deciding whether to adopt for their own national plans the low-power, multi-station system or that employing a small number of high-power transmitters.

Before going further it may be well to record my firm conviction that we shall shortly have to revise our ideas about the propagation of radiation of the wavelengths used for television. Several such revisions have already occurred. It was at first believed that these "quasi-optical" waves had a range very little greater than that of the horizon visible to the eye from the transmitting aerial. It was then found that they might be bent so as to follow the curvature of the earth's surface further beyond the visible horizon than had been expected. Up to at any rate 1942 the accepted formula for their maximum normal range was:—

$$d = 1.32\sqrt{h}$$

where d = distance in miles,
h = height of transmitting aerial in feet.

By 1947 it had been found that the bending in the

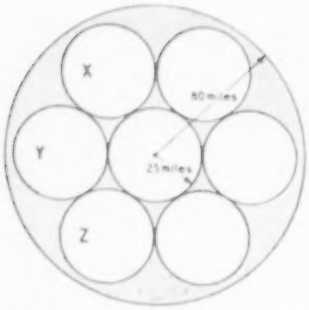


Fig. 1. Seven transmitters with a range of 25 miles (small circles) would not fully cover the service area of a station with a range of 80 miles (large circle).

Fig. 2. For the seven transmitters of Fig. 1 at least three different channels are needed.

atmosphere was greater than had been calculated and the formula was altered to:—

$$d = 1.44\sqrt{h}.$$

With phenomena such as atmospheric ducts and sporadic ionization we are not concerned. These may allow reception to take place at enormously greater ranges; but they are seasonal or occasional effects and cannot therefore be taken into account when discussing service areas. Data, however, have accumulated to show that signals on wavelengths of 4·7 metres are regularly and consistently received at ranges considerably greater than those indicated by the propagation laws at present accepted.

For good television reception it is not sufficient that a signal of some kind is received. Field strengths large enough for intelligible reception of telegraphy, or even of telephony, may be insufficient to provide worthwhile television results. The television signal must be strong enough to override at all events mild forms of interference, to "hold" the image with clean-cut sync pulses and to "paint" a picture with plenty of contrast. Thus, though we are likely to find that the range to which 4·7-metre waves can travel in normal circumstances is greater (possibly considerably greater) than is now generally believed, I expect that the practical effects on calculated and observed ranges for television transmissions will be of real importance only where high-powered transmitters are concerned. In other words, what is needed for good television reception is a certain minimum number of microvolts per metre; and to ensure such a field strength at long range a powerful transmitter is essential.

Service Areas

The actual service area of any radio or television transmitter is never exactly circular; there are in its contour always some salients, representing abnormally long ranges in certain directions, and re-entrants which represent abnormally short ranges in others. Generally speaking, though, it is roughly circular in shape, and calculations of the size of the region covered by a television station will not be greatly in error if we regard its service area as a circle. One of the inescapable laws of mathematics is that the area of a circle is πr^2, where r is the radius.

Observations confirm that the normal range of a 5-kW television transmitter with a good aerial system is 10-15 miles. Let us call it 15 so as to be on the generous side. Its service area, then, contains a little over 700 square miles. The 17-kW London station has an accepted average range of 30 miles, which means a service area of rather over 2,800 square miles. The expected range for the 35-kW Sutton Coldfield, calculated on a very conservative basis, was 50 miles with a service area of nearly 8,000 square miles. The range has proved to be about 80 miles, with a corresponding service area of 20,000 square miles.

Fig. 1 shows two ways of providing a television service in a particular region of approximately 20,000 square miles. One is to use a 35-kW transmitter; the second is to operate a number of smaller stations, each with a range of 25 miles. It will be seen that at least seven such stations are required and that even these are likely to give an unsatisfactory service, or even no service at all, in a considerable part of the area.

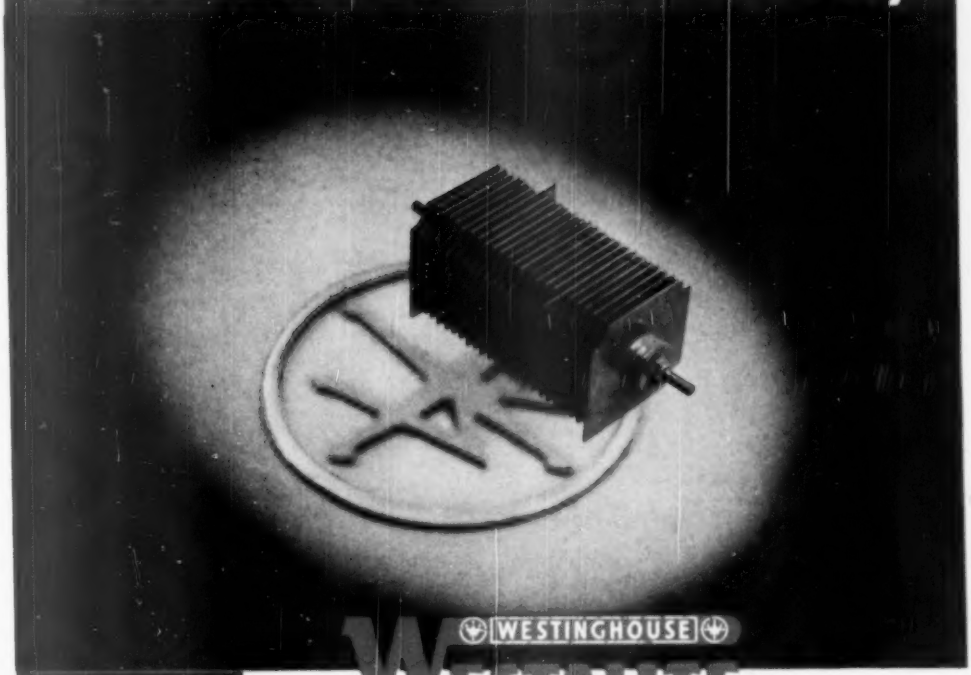
Fig. 2 illustrates another problem which arises when an area is covered by a number of stations: to avoid mutual interference no two adjacent transmitters must operate on the same frequency. As Fig. 2 shows, three frequencies at least are needed for such a group of stations. This has other implications: (1) any receiver used in this area must be selective enough to reject the two unwanted frequencies; (2) in order to avoid a multiplicity of specialized models, all receivers sold in the area must be tunable to any of the three frequencies. Each of these requirements makes the receiver more expensive to produce.

Question of Population

It seems probable that the simplest way of providing a television service in any area up to at least 20,000 square miles is to install a high-powered transmitter with a high and efficient aerial system. But the problem is not quite so straightforward as that; much depends upon whether the area as a whole is fairly densely populated and, again, whether the population is almost equally dense in all parts of it. If the circles marked X, Y and Z in Fig. 1 represent desert or sparsely inhabited regions, and if there are few people living north, south or east of the country covered by the large circle, it would clearly be folly to provide a television service by means of a transmitter with a range of 80 miles. A number of small stations would be the wiser choice.

What it comes to is that small, thickly populated countries would almost certainly find that the most economical service, from the points of view both of the authorities and of the viewers, would be provided by the installation of one or more high-power transmitters. For those with a large percentage of their population living, as is the case in Australia, India and Canada, in and around a comparatively small number of big towns, the most desirable system may be a combination of high power urban stations and chains of small relays of the unattended type serving outlying districts. In countries which have mainly rural populations and in those whose mountainous nature reduces the normal range of e.h.f. transmissions, considerable numbers of very small transmitters (probably relaying from a main centre and working unattended) may prove the best system. One cannot say that the high power system is in all circumstances better than the low power, or *vice versa*; each country must decide which system, or what combination of the two systems, is going to give it the best results.

BACKGROUND *to reliability*



WESTINGHOUSE

WESTALITE RECTIFIERS

RECTIFIERS FOR H.T. SUPPLY TO RADIO RECEIVERS

H.T. and E.H.T. SUPPLIES TO TELEVISION RECEIVERS

SOUND and VISION INTERFERENCE SUPPRESSION

POWER SUPPLY TO RADIO TRANSMITTERS

have behind them the accumulated design and manufacturing experience of over 25 years development and production of metal rectifiers. The first Westalite rectifiers, which were installed ten years ago, are still operating satisfactorily and may be expected to at least equal the records of the original copper-oxide types, many of which are still in operation after 21 years' service.

Rectifier units and equipments are available to meet all the needs of the radio industry—for power supply to receivers and transmitters—for the operation of D.C. machine tools—for electroplating.

Write for literature or send details of your requirements to Dept. W.W.E.4

WESTINGHOUSE BRAKE & SIGNAL CO. LTD., 82 YORK WAY, KING'S CROSS, LONDON, N.1

LATEST ADVANCE IN SPEAKER DESIGN

NOW AVAILABLE FOR EXPORT!

THIS latest application of the well-known series gap magnet system (originated by us in 1935) comprises two separate loudspeakers, concentrically mounted, but each operating independently and furnished with its own speech-coil, gap and diaphragm. The centre pole is hollow, and forms the beginning of the pressure horn which loads the convex high-frequency diaphragm situated at the rear. In front this pole-piece is surrounded by a separate gap in which the low-frequency speech-coil operates.

The curve given below will show why this new twin-reproducer has been so enthusiastically welcomed: never before has so wide a range been covered so evenly by a domestic instrument of this size and at so small a cost. Full details on request: trade enquiries invited.

SPECIFICATION: 10" Die-cast Chassis. Series Gap magnet of Alcomax 3. Flux in LF gap 12,000 gauss on 1" pole. Flux in HF gap 13,000 gauss on 1" pole. Power handling capacity, 6 watts. Frequency range 50-14,000 c.p.s. Fundamental bass resonance, 65 c.p.s.

CHASSIS complete with condenser and transformer, price in U.K. - - **£6 - 6 - 0**

CONCENTRIC DUPLEX SPEAKER IN DE LUXE CABINET: Price with transformer - - £11 . 3 . 0
Without trans. - £10 . 10 . 0

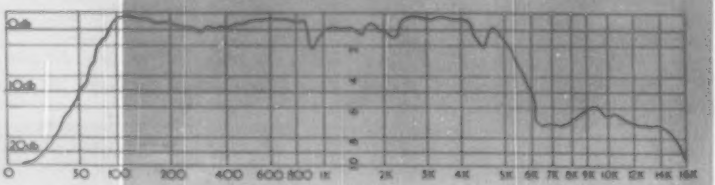
TWIN CORNER REFLEX CONSOLE LOUDSPEAKER incorporating Duplex Unit and fitted with individual Volume Controls for mixing. Polished Walnut Veneer Cabinet (2' 6" x 1' 7" x 8½"). Price with transformer £13 . 5 . 0
Without trans. - £12 . 12 . 0

Concentric Duplex

A new speaker for the quality enthusiast

WHITELEY ELECTRICAL RADIO CO. LTD.
MANSFIELD · NOTTS

Response curve of Concentric Duplex speaker with cross-over network in frequency circuit.



"CATHODE RAY"

COMES DOWN TO EARTH

—*And Explains Some of the Finer Points of the Radio Valve*

THE extent to which I have drifted from my original simplicity has been strikingly brought home to me by seeing several of my recent articles actually mentioned in that stratospheric-brow journal, *Wireless Engineer*. No doubt the toddlers who, in pre-war days, grappled with my attempt to explain the difference between resistive and reactive ohms in terms of a game of blow football, have now reached the age at which "Filters" (in two parts) is easy meat. But if I were to continue in phase with them while they advanced into the mathematical intricacies of non-linear networks, I would lose touch with readers who need help in understanding the learned mandarins who write the rest of *Wireless World*. In short, it is time for the flyback.

This introduction is merely to warn sophisticated readers not to continue in the hope of finding subtleties buried under the common or garden title above. It is going to be strictly elementary.

What use is the earth? What use, that is to say, apart from supporting life? The question must often have leapt into the more innocent public's mind when the earth wire became detached and the radio kept on playing pretty much as before. (The less innocent, of course, reply "Earth? I don't use it, old man," or perhaps just smile pityingly, as though one had called their attention to a "No Smoking" notice. And when they buy an electric appliance with a three-wire flex, they attach a two-pin plug to the most likely looking pair and hope for the best.)

Saving Aerial Wire

Is earthing, then, a practice of the ignorant or conscientious or pedantic few, and scorned by the rest as "just one of those regulations"? And do the rest always get away with their indifference to it?

The argument is likely to be rather confused unless we disentangle the various uses to which the earth is put. In pre-wireless days it was used as an inexpensive electrical conductor, saving the cost of a return wire in a telegraph system (Fig. 1). Although most soils are poor conductors compared with copper, the earth makes up for that by its considerably fatter gauge—provided that one makes the contact plates sufficiently large.

When wireless came along, the uninitiated thought they understood how one half of the connection between stations was established, for there was the same earthing as in Fig. 1; but they were completely baffled by how the other half went through the air. If Marconi's system had used a dipole or microwave aerial, without any earth connection, people would not have been misled by this apparent resemblance to Fig. 1. As things were, the buried-plate earth was an important feature of his system, but for quite different reasons. He used it as the lower half of a vertical aerial, or one plate of an opened-out capacitor. If he, and the person to whom he was signalling, had been floating in space, they would have been

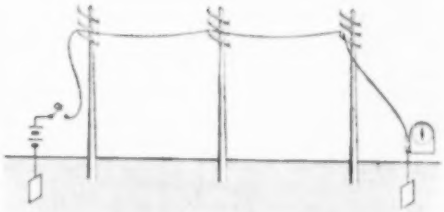


Fig. 1. Nineteenth-century use of "earths" to save telegraph wire.

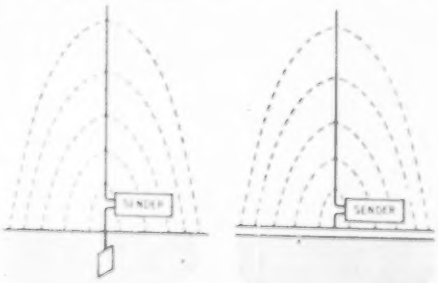
obliged to use aerials more or less like the present television dipoles. An outstretched electric field, such as is necessary for radiating wireless waves, cannot be produced unless there are *two* bodies between which to produce it. The dimensions of these bodies are preferably not too far short of a quarter of the length of wave to be radiated. So for medium and long waves the best length of aerial is long enough to make one welcome the opportunity of using the earth as one of the bodies, leaving only the other to be provided.

This stage in history, which is still with us, can be represented by Fig. 2, with a few of the imaginary lines of electric force drawn in between aerial and earth.

If you lay a large mirror on the floor to represent the earth, and stand a walking stick or something on it to represent an aerial, what you will see is this "aerial" and (apparently) another one exactly the

Fig. 2. (Left) Twentieth-century use of earth to save aerial wire.

Fig. 3. (Right) For long-wave stations, the natural earth is usually false economy, so an artificial earth or "earth screen" is used.



same, pointing downwards below the surface of the "earth." Since light waves and wireless waves are exactly the same except for wavelength, this is a real working model illustrating the fact that, by virtue of its reflecting powers, the earth is equivalent to a mirror image of the aerial. (The reason why one can't actually see the image, except when the wireless station happens to be afloat on calm water, is that light consists of such extremely short waves that they are scattered by all except very smooth surfaces.)

Like most cheap substitutes, this half-aerial is not quite as good as the genuine article. If the earth were made of pure copper, or at any rate surfaced with it, there would be little to complain of (in this particular respect). Sea water is good enough for practical purposes, and there would even be something to be said for a perfect insulator (which, like a sheet of unsilvered glass, gives a partial reflection). But ordinary soil is neither; it acts as a resistance load, absorbing valuable radio-frequency power. This loss is particularly serious at very long wave stations, where the resistance of the aerial proper can be made very low. So at such stations it is customary to lay down an "earth screen" of copper wires or netting, Fig. 3, close to the surface of the ground (above or below).

Protection from Lightning

An artificial earth something like this was also used for the comparatively short waves of radar stations during the earlier years of the war. It was not for providing a low-loss half-aerial (for self-contained dipole aerials were used), but to ensure regularity of reflection where the earth itself was not quite level. The importance of this, especially in radar, is that the strongest radiation from the station rises at the angle where the radiation direct from the aerial and the radiation reflected from the surrounding earth (natural or artificial) are in phase.

All these things apply at the receiving end too. If so, then, how is it that it seems to make so little difference whether we earth or not?

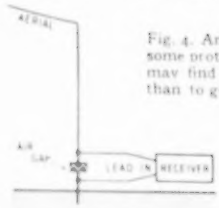
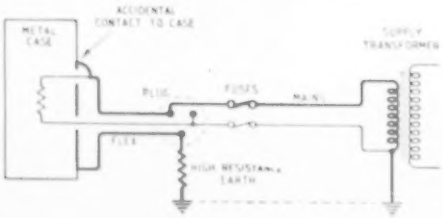


Fig. 4. An earth arranged like this gives some protection against lightning, which may find it easier to cross the air-gap than to go through the receiver.

Fig. 5. (Below) Earthing domestic appliances protects the user against shock due to faulty insulation, but only if the resistance of the connection is low enough to make the fuse blow promptly.



Part of the answer lies in the fact that even the cheapest receivers are generally four-valve superhets, capable, with a good aerial-earth system, of receiving distant or weak stations; yet most listeners rarely, if ever, use them for anything beyond the powerful locals. So there is a vast amount of reserve, and all that happens when the earth wire is removed is that the a.g.c. brings this reserve into action and so keeps the volume nearly the same as before. This increased amplification is likely to bring in some noise as well; but that is a different story.

Taking history another step forward, we come to television. For reasons which have often been explained, it is organized on wavelengths which make the best length of aerial only a few feet long. So if the system in Fig. 2 were adopted, the whole of the aerial would inevitably be within a few feet of the earth. On most sites this would mean that it would be coyly hiding behind all sorts of obstructions which short waves find it difficult to get round or over. Fortunately the economy motive is reduced in proportion to the wavelength, so it is no great hardship to provide both halves of the aerial, which can then be mounted as high as practicable, free from all obligation to the earth. Is the earth therefore quite unnecessary? And if so, why are television receiving systems earthed?

These questions bring in some of the other uses of the earth. One of them is protection against lightning. Although some lightning flashes take place between two clouds, many are from cloud to earth, and if the most convenient spot to strike happens to be a high-sited aerial (television or otherwise) and that aerial leads into a *cul de sac* in the form of the receiver, it may be just too bad for the receiver. But if there is a comparatively straightforward by-pass to earth (even if it includes a short air-gap) the receiver will be reasonably safe. The heavy momentary currents in lightning set up dangerously large potentials across even small inductances, such as bends or loops in the aerial or lead-in wires, but have little difficulty in bridging short gaps. So an arrangement like Fig. 4 is usually quite good. Something of the kind, in conjunction with fuses in the branch, is used to protect telephones, as I discovered the other day after a thunderstorm. The earthing switches that used to be recommended have the disadvantage that there may not be anyone to work them when a thunderstorm comes on; or, if there is, the lightning might happen to strike while his hand was on the switch. Although the lightning risk is admittedly very small, it is better to be on the safe side.

Earthing the Receiver

A considerably greater risk is electric shock. Quite a number of people are killed every year by it; and even if you aren't killed it can be unpleasant. Probably the commonest danger is caused by the live side of the mains making accidental contact with the metal parts of an electric appliance, such as a kettle, iron, or lamp. When this happens (often due to frayed flex), and the metalwork is not earthed, it is all ready to hand out shocks. But if it is earthed—and that is the reason for the third wire—the fault causes a fuse to blow and investigations to be made.

To be a real protection, the earthing must have a low resistance. If not, we get the state of affairs shown in Fig. 5, in which a fault current flows as

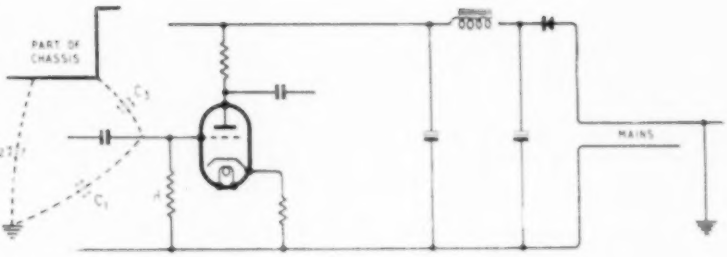


Fig. 6. From this one can work out why, in a.c./d.c. sets, the chassis must be made potentially "live" in order to avoid excessive hum.

indicated by the heavy line, but the earth resistance limits it so that the fuse either doesn't blow at all, or there is an appreciable delay, during which the case is fully live. An earthing rod stuck into the dry soil under the eaves is not good enough. Photographic evidence has been adduced to show that even the flower-pot earth is not a mere comedian's fable!

A radio set is less likely than most domestic electrical appliances to be a danger when its metalwork comes in contact with the mains, because it is generally covered up by a cabinet. This is just as well, with a.c./d.c. sets at least, because in most of them the chassis is deliberately connected to the mains. Seeing that from the safety point of view this can hardly be considered ideal, there must be a strong reason for doing it. This reason is that otherwise it is extremely difficult to avoid an intolerable amount of hum.

To understand why, consider the audio-amplifying part of the set—say the triode part of the double-diode-triode in most models—together with the mains connection (Fig. 6). Suppose for the moment that there is no surrounding metalwork. There will, therefore, inevitably be some stray capacitance, C_1, between the grid of the valve and earth. But if the side of the mains connected to the rectifier happens to be the one that is earthed, the whole mains voltage (assuming it is an a.c. supply) will come across C_1 and R in series. Since R is normally of the megohm order, and a small fraction of a volt across it is enough to cause hum, C_1 does not have to be exceptionally large to give trouble.

The answer to this, you may say, is to reverse the mains plug so as to bring the earthed side to cathode. Certainly, for a.c.; but what about d.c.? One is then obliged to connect so that the rectifier side is positive, and about half the d.c. mains have the positive earthed. So there is no getting away from it. While it is true that pure d.c. can't cause hum, d.c. mains invariably have a ripple which, though less in voltage than the d.c. itself, is comparatively high in frequency and therefore the more able to infiltrate via C_1. It is also far more audible than 50 c/s.

Suppose, next, that in order to cut out C_1 the usual metal chassis and screening are used, and to avoid connecting it to the mains, it is left floating, as shown in Fig. 6. It will almost certainly make matters worse, for it will have a considerable stray capacitance to earth (C_2) and also (compared with C_1) to grid. C_1 is therefore merely replaced by C_2 and C_1 in series. Earthing the screens increases the total stray still further, by short-circuiting C_2.

So to ensure freedom from hum on all mains, one is obliged to stick to the usual practice of joining the negative side of the receiver circuit to chassis. And if the set is to work on d.c. mains this inevitably means connecting it direct to the mains, so there is a fifty-fifty chance of the chassis receiving full mains voltage.

The radio manufacturer who believes in keeping his customers alive to buy from him again, not only takes care to cover up all the metalwork—not forgetting the grub-screws on the control spindles—but also arranges matters so that one cannot get at it without unplugging the mains. For the same purpose, he insulates the aerial and earth terminals from the rest of the set, using either inductive coupling or capacitances not large enough to deliver a devastating shock.

Why Not a "Mains Earth"?

Obviously an earthable chassis is a surer and more convenient safety measure; and except for sets which may have to be used on d.c. there is no difficulty in arranging it, because the mains can be isolated by means of the usual transformer. Fig. 6, with the negative side of the valve circuits at alternating potential, is just an unfortunate abnormality. Normal practice is to earth the negative. Although a floating chassis would not then introduce hum by its stray capacitance to earth, as in Fig. 6, it would probably do so by its stray capacitance to the mains or other alternating potentials. So to be effective against electric fields, a screen must be tied down to an appropriate potential, preferably earth. This is no doubt what "Free Grid" had in mind when, some years ago, he investigated complaints of electrostatic interference arising from the stroking of cats by old ladies. His conclusion, it may be remembered, was that the only complete cure was to permanently earth the cats.

The desirability of earthing having now been established, the reader who is still reluctant to dig deep holes in the moist subsoil, or even to run a wire from a rising water main, may point out that (as shown in Fig. 5) one side of the mains is itself soundly earthed, so why not earth the set simply by connecting it to the earthed mains lead (the "neutral") as in Fig. 7?

One reason for not doing so would become only too clear if the set were plugged in the wrong way round! Among other reasons, the length of wire between the receiver and the earth connection at the supply end generally picks up an unpleasant assortment of electrical noises created by the neighbours' appliances. (Your own, of course, will all be noise-free or thoroughly "suppressed"!). Using this wire as an earth connection, you have these noise-

voltages right in the aerial-earth system, where they can make the maximum nuisances of themselves (Fig. 7). Moreover, any anti-noise filters the set may contain depend on direct earthing for their effectiveness. The advice to make the earth lead short is, after all, well-founded, and is *not* fulfilled by relying on a "mains earth." Incidentally, you are forbidden to earth the neutral at your end.

Stray Capacitances

One of the first things that have to be understood before making accurate measurements of capacitance is that it has no precise meaning unless the capacitor (or a surrounding screen) is earthed. Suppose C represents the capacitance between the terminals of a low-value standard capacitor (Fig. 8(a)). That might seem to be all one need know. But the plates, terminals and connections have some capacitance to the surroundings (which for simplicity we shall assume are all earthed). These capacitances are represented by C_1 and C_2. Being in series across C, they add to it. So one cannot just get C by itself. Even if the values of C_1 and C_2 can be found, they are upset whenever you (an earthed body) move nearer or farther away, or the capacitor is shifted.

Either C_1 or C_2 can be got rid of by earthing one of the terminals; but as it is unlikely that C_1 and C_2 are exactly equal, the value of the capacitor will depend on which terminal is earthed. The way out of the difficulty is to put the capacitor inside a metal screen, so that the only stray capacitance (C_2 in Fig. 8(b)) is to the screen and is therefore unaffected by what goes on outside. The stray capacitance of the screen to earth is then eliminated by earthing it, and the total capacitance is $C + C_2$.

Stray capacitances affect the a.c. values of resistors and inductors, too; so an important use of earthing in lab. work is to make these values definite. The same applies to potentials. If a piece of apparatus is floating (i.e., not earthed), the potential of any part of it is indefinite, depending on stray leakages and other chance effects. The potential of earth is reckoned as zero, so by earthing the apparatus somewhere all its potentials are made definite.

One sometimes comes across the expression "earthy." This is not, as might be supposed, a quotation from the Burial Service (even when read over "Free Grid's" aunts' cats), but a convenient way of describing terminals or other points in a circuit which may not actually be connected to earth but which normally have little or no alternating potential. Of the two input or output terminals of an amplifier, one is generally connected to h.t.– and would be regarded as "earthy," in contrast to the terminal connected to grid or anode.

Summing up the uses of earthing, then, we have: supplying the lower half of an aerial; controlling the angle of radiation or reception; protecting from lightning and electric shock; excluding hum and other noise; regularizing circuit values and potentials.

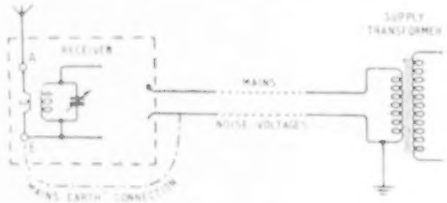
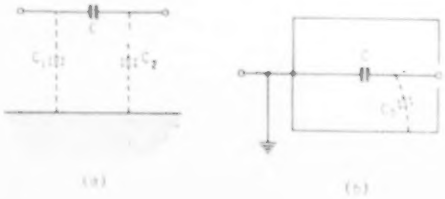


Fig. 7. One reason why it is not a good idea to rely on the mains as an earth.

Fig. 8. (a) The exact capacitance of an unscreened capacitor is indefinite, owing to the "strays," C_1 and C_2. (b) For exact measurements, the capacitor should be screened and earthed.



PUBLISHED REPORT

Naturalness in Speech Reinforcement Systems

SOME recent German research work has been concerned with the effect on the naturalness of speech sounds of a reinforcing signal following the original sounds within a few milliseconds. This work has been carried out by Herr H. Haas under the direction of Professor E. Meyer, University of Göttingen, and has given two main results which are summarized as follows.

First, if the reinforcing signal from a secondary source (e.g., loudspeakers) reaches the listener at least five milliseconds after the sound from the primary source (e.g., the actual speaker), then all of the sound appears to be coming from the primary source. This effect continues even if the secondary source is 10 decibels greater than the primary source, and is almost independent of the positions of the primary and secondary sources.

Secondly, if the time difference between the primary and secondary sounds reaching the listener is increased, a stage will of course be reached where the secondary sound is heard as a distinct echo. But before this occurs the secondary sound will have begun to have a bad effect on the naturalness of the speech sounds. The critical time differences have been investigated as a function of the relative intensities of the primary and secondary sources. For instance if the secondary sound is 10 decibels greater than the primary sound then the maximum permissible time difference before the naturalness is affected is about 25 milliseconds.

As these German results are of obvious importance in the design of speech reinforcement systems, and as this work would not normally be published, the Department of Scientific and Industrial Research has had the paper translated. Copies of the translation may be obtained, free of charge, by interested organisations and firms on written application to The Director, Building Research Station, Garston, Watford, Herts.

"STEREOPHONIC" AMPLIFIER

This new amplifier with triode cathode-coupled output stages has the effect of making the reproduction more like the original than ever before. A small proportion of this improvement results from the reduction of the Doppler effect, which is achieved without lowering the damping factor on the speakers, with the consequent distortion and transient loss which would follow.

When listening to an orchestra the low frequencies are usually heard towards the right, and the high frequencies towards the left. When reproduced through the Vortexion "Stereophonic" amplifier with low and high frequency speakers suitably spaced according to required listening angle, the high and low frequencies are heard in their relative positions simulating the effect and appreciation of the original.

This speaker placing is necessary because our ears are on a horizontal plane. The effect would be lost if our ears were positioned one above the other, as can be proved by inclining the head sideways.

Our efforts to achieve "Stereophonic" results by the use of various choke and condenser cross-over networks between the amplifier and speakers were unsuccessful, due to the large variation of speaker impedance at various frequencies, unevenly loading the resonant circuits.

After many months of research we finally achieved our aim with what is basically two special low-distortion, high-damping factor amplifiers in one, each covering a portion of the audio spectrum with a sharp cut per octave at change-over frequency. The acoustical efficiency of the bass and treble speakers may vary, so a balancing control is fitted to the amplifier. This simplifies the choice of speakers, since each speaker has only a narrow frequency coverage.

The "Stereophonic" amplifier is now in production, and we invite you to hear a demonstration of what we believe to be something new and which will add to your enjoyment of music.

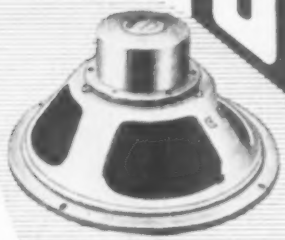
Chassis complete with valves

Price 36½ gns

VORTEXION LIMITED, 257-261 THE BROADWAY, WIMBLEDON, LONDON, S.W.19

Telephones: LIB 2814 and 6242-3 Telegrams: "Vortexion, Wimble, London."

ROLA G12



Maximum sensitivity with uniform frequency response from a more compact speaker, appreciably reduced in weight—that is what Rola technicians have achieved with the new G.12. Special features include dust-proof suspension completely protecting coil and magnet gap and the powerful Alcomax II magnet. Write for details and also for particulars of Rola 3" and 4" P.M. models, dust-proofed and equipped with Alcomax II magnets.

best of the BIG speakers

BRITISH ROLA · FERRY WORKS · SUMMER ROAD · THAMES DITTON · SURREY

Telephone EMBERBROOK 3402 (5 lines)

"YANKS ROLL IN LIKE LOCALS"

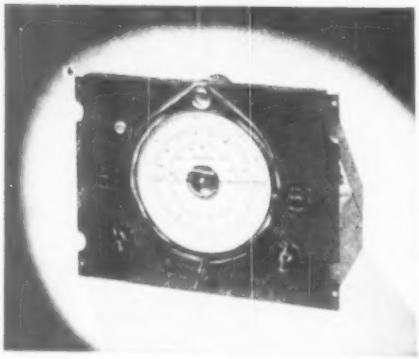
WHEN YOU HAVE A "D.X. PLUS TWO FEEDER UNIT" working in conjunction with the **"TONEMASTER AMPLIFIER."**

Every feature to ensure good listening is incorporated in this equipment, including Tone Controls, and Master Volume Controls brought out to a separate panel to facilitate mounting.

THE "D.X. PLUS TWO FEEDER UNIT" covers from 5 to 2,000 metres in five overlapping steps, plus infinitely variable selectivity, tuning indicator, etc.

THE "TONEMASTER" AMPLIFIER incorporates push-pull output, negative feedback and separate electronic tone control circuits.

OVERALL COST **£44.10.0** plus purchase tax.



SOUND SALES' PRODUCTS are backed by 12 MONTHS' GUARANTEE, plus 20 years' experience in the manufacture of electronic equipment.

Sound Sales Limited

London Office, Demonstrations—**LLOYDS BANK CHAMBERS, 125, OXFORD STREET, LONDON, W.1.**

Telephone Gerrard 8782.

Head Office and Works—**WEST STREET, FARNHAM, SURREY.** *Farnham* 6461/2/3.

Solving Parallel Problems

Unconventional Formula Suitable for Quick Mental Calculations

By D. A. POLLOCK (*Engineering Division B.B.C.*)

MOST of us who are concerned with radio in its many and varied aspects have occasion to use Ohm's law, and early in our acquaintance with this law we discovered that when using resistances in series the value was easy to find. We just added their respective values. When we came to putting resistances in parallel we found that it was a different matter. There was a formula :—

$$R = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}} \text{ etc.}$$

Some of us do not carry around slide-rules for working out reciprocals and the rule of thumb routine is apt to be tedious. There was an alternative formula for two resistances in parallel :—

$$R = \frac{R_1 \times R_2}{R_1 + R_2}$$

This is the accepted formula at present in general use, and unless the values of R_1 and R_2 are fairly simple figures it still requires either the slide-rule or pencil and paper.

Now when we parallel two resistances, we know at once that the combined value will be lower than that of either single resistance. Let us start from the most elementary values and observe their relationships. To find the combined value R when we parallel R_1 of 1Ω with R_2 of 2Ω; using the conventional formula we find that the answer is $2/3\Omega$, which is $1/3\Omega$ lower in value than R_1. So far there is nothing significant except that we note that a new figure, 3, appears in the answer which is related to 2 and 1. Let R_1 be 1Ω and R_2 be 10Ω. Then R is 0.909Ω. R_1 was 1/10th of the value of R_2, but R is not 1/10th lower in value than R_1 but 1/11th, i.e., R_1 minus (R_1 divided by 10 plus 1). Now add some noughts to the figures and let us see if this relationship still holds good. Let R_1 be $1{,}000\Omega$ and R_2 be $10{,}000\Omega$. Then R is 909Ω, still 1/11th lower than R_1.

Take some different figures: let R_1 be 56Ω, and R_2 be 280Ω (five times greater), then R is 46.6Ω, which is 1/6th lower than R_1. What is happening is that the combined value is following a relationship which is in proportion to the "ratio" of the resistance values, with the distinction that there is always figure 1 added; so all we need to do is to look at the values of R_1 and R_2, mentally assess the ratio of R_2/R_1, and add 1. Divide R_1 by this figure and subtract the result from R_1 to get the answer for R.

For example: find the parallel value R when R_1 is 33Ω and R_2 is 66Ω. The ratio R_2/R_1 is $66/33 = 2/1$. Add 1, which gives the divisor 3. Then $R = 33 - 33/3 = 33 - 11 = 22\Omega$. This method can be stated in the formula :—

$$R = R_1 - \frac{R_1}{\frac{R_2}{R_1} + 1}$$

which can be shown to be the equivalent of the usual formula.

Having shown that resistances in parallel follow a "law" related to the ratio of their values, a further simplification can be introduced, namely :—

$$R = \frac{R_2}{\frac{R_2}{R_1} + 1}$$

which, again, can be shown to be the equivalent of the usual formula.

We need only look on R_2/R_1 as a simple ratio to get sufficient accuracy for most practical requirements. Even where the experienced designer of radio circuitry wants accuracy with speed it will surely be agreed that this unconventional formula has advantages over the generally accepted one.

To take an example, let R_1 be $8{,}000\Omega$ and R_2 be $24{,}000\Omega$. Then substituting values, the parallel value will be :—

$$R = \frac{24{,}000}{\frac{24{,}000}{8{,}000} + 1} = \frac{24{,}000}{3 + 1} = 6{,}000\Omega$$

Reversing the values of R_1 and R_2 :—

$$R = \frac{8{,}000}{\frac{8{,}000}{24{,}000} + 1} = \frac{8{,}000}{\frac{1}{3} + 1} = 8{,}000 \times \frac{4}{3} = 6{,}000\Omega$$

The formula applies equally to impedances wherever phase angle is not involved. Where Z is resistive :

$$Z = \frac{Z_2}{\frac{Z_2}{Z_1} + 1}$$

which is a useful formula for the quick calculation of parallel loads. Similarly for parallel inductances :—

$$L = \frac{L_2}{\frac{L_2}{L_1} + 1}$$

Parallel capacitances are simply added together as are series resistances, but we can adapt the formula for capacitances in series :—

$$C = \frac{C_2}{\frac{C_2}{C_1} + 1}$$

Simple examples have, of course, been chosen for convenience in demonstrating the general principle. The formula is easy to memorize, and speed in using it will soon come with practice. Finally, here is a useful application of the "ratio" idea which needs no formula to express it. We have a resistance (or a load) of 55Ω and we want to bring it down to 50Ω. Let R be 50Ω and R_1 be 55Ω and R_2 be the parallel value required. Visualize R_1 split into its two parts (R_1 minus R) and R. Then ($R_1 - R$) is to R, as R_1 is to R_2. That is, $5 : 50$ as $55 : R_2$. Almost at a glance R_2 is 550Ω.

Electronic Circuitry

Selections from a Designer's Notebook

By J. McG. SOWERBY (Cinema-Television, Ltd.)

STABLE C.R.O. TIME-BASE

A LINEAR time-base is commonly employed in cathode-ray oscilloscopes, and to meet varying requirements its frequency is usually made variable over a wide range. The controls which effect this variation may be calibrated if the time-base is sufficiently stable, and this facility is very useful for giving a rapid guide to the time scale of the waveform under observation. The terms in which the controls are calibrated will depend on how the oscilloscope is to be used; it is often convenient to calibrate the controls in terms of frequency, rather than time, if sine waves and similar repetitive signals are to be viewed and the time-base is of the continuously repeating type. On the other hand, if a triggered or single-stroke time-base is used, only calibration in terms of time is practicable or directly useful. With a continuously repeating time-base calibrated in terms of frequency, the rise and fall of singularities in the waveform to be observed are easily timed because the interval taken by one complete sweep of the time-base is merely the reciprocal of the calibrated frequency (within the tolerances mentioned later).

If a condenser-charging (or discharging) type of time-base is to be calibrated, several awkward problems arise, most of which derive from the fact that simple time-bases are, as a rule, inherently unstable devices. For example, although it is not a difficult matter to control the charging current in a time-base with fair accuracy, it is much more difficult to be certain that the amplitude of the saw-tooth will remain constant with ageing valves and components, and when replacements are made. Because the amplitude of the saw-tooth waveform is inversely proportional to the frequency of the saw-tooth for a given charging current, it is necessary (as can be seen from the full line and dotted saw-tooth waveforms of Fig. 2 (a)) to regulate the amplitude of the saw-tooth in some way if the controls are to be calibrated in terms of frequency. Again, the fly-back time must either be negligible or a constant fraction of the time occupied by the forward sweep, or calibration at one end of the frequency scale will not hold at the other.

The aforementioned requirements are fairly well met in the following circuit, in which the frequency controls may be calibrated with a fair degree of accuracy. The principle[1] adopted in this circuit is that of artificially constraining the amplitude of a time-base within fixed and predetermined limits, so that the resultant amplitude of saw-tooth waveform is less than that which would otherwise be obtained. The limits of the constraint imposed are defined by direct potentials, so that they may be controlled by a relatively stable device such as a gas discharge stabilizer tube.

Fig. 1 is a block diagram showing how the circuit is arranged. The output from the saw-tooth generator is fed into two comparator circuits FB_1 and FB_2, and when the amplitude of the saw-tooth approaches equality with the potential E_1 the fly-back is forcibly initiated. The fly-back proceeds in the usual way until the output amplitude approaches equality with E_2, and at this instant the fly-back is forcibly suppressed and the sweep begins again. Thus the amplitude of the saw-tooth is constrained to be nearly $(E_2 - E_1)$.

Fig. 3 shows one arrangement of the circuit which, although probably not the simplest, is easy to follow because the various functions are separated into blocks corresponding to Fig. 1. The components R, C, V_1 and V_2 form a normal Puckle time-base[2], the output saw-tooth being obtained at the cathode of V_2 as is usual. As C charges through R, to form the sweep part of the waveform, the potential of the grid of $V_3(b)$ is taken steadily negative until it approaches that of $V_3(a)$—which is E_1. $V_3(a)$ now begins to conduct (having so far been held at cut-off by the cathode current of $V_3(b)$ through the common cathode load) and in doing so it applies a negative

[1] British Patent No. 624,022.

[2] "Time Bases," by O. S. Puckle. 1st Ed., p. 40.

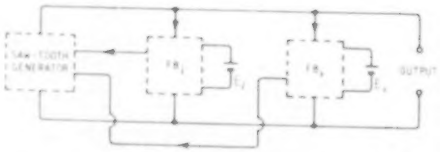
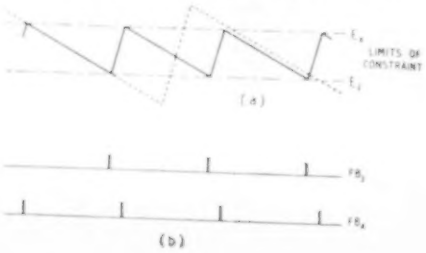


Fig. 1. Block diagram of the circuit, showing how the upper and lower limits of constraint, E_1 and E_2, are applied by two separate comparators, FB_1 and FB_2.

Fig. 2. At (a) is shown the output saw-tooth (full line), and the output (dotted) that would be obtained in the absence of the FB_1 and FB_2 circuits. At (b) are the corresponding control pulses produced by FB_1 and FB_2.



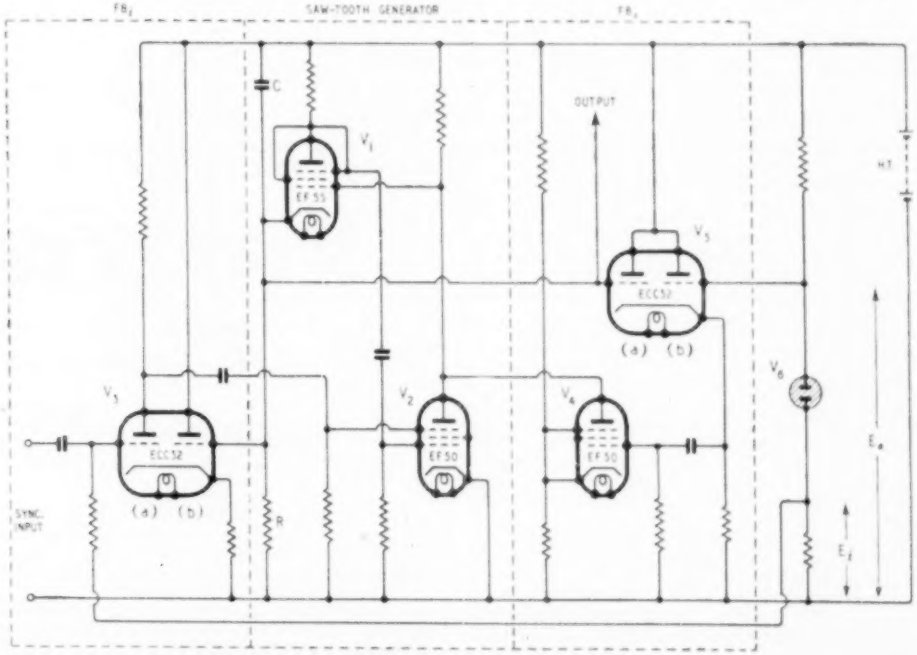
going amplified saw-tooth to the suppressor grid of V_1. As a result the anode potential of V_2 rises, so that V_1 begins to conduct. Note that for this to be possible, the standing anode potential of V_2 must be less than E_1. As soon as V_1 is sufficiently conducting, V_2 is cut off at its control grid in the usual manner of a Puckle time-base, and since the grid of V_1 is returned to the h.t. line the impedance of V_1 falls to a very low value. This allows C to discharge very quickly, and the cathode potential of V_1 moves rapidly positive, taking with it the grid of V_3(b). The anode of V_3(a) now goes positive (owing to increased current through the common cathode resistor) and so the negative pulse on the suppressor grid of V_2 collapses; but this is of no importance, since V_2 is held at cut-off by the potential applied to its control grid by the time the collapse takes place.

The time-base is now well into its fly-back mode, and as a result, the grid potential of V_3(a) now moves rapidly in a positive sense. Eventually the grid potential of V_3(a) approaches that of V_3(b), and V_3(a) begins to conduct. In consequence the common cathode potential of V_3 begins to go positive, taking with it the grid of V_1, which has hitherto been cut off by the bleeder current through its cathode resistor. As soon as V_1 conducts sufficiently, the common (V_2, V_4) anode potential falls and V_1 is cut off, so that the fly-back mode is forcibly suppressed. The resultant onset of the negative-going sweep soon produces a collapse of the pulse at the grid of V_4, but this is unimportant because the cessation of the fly-back allows V_4 to conduct again and this is, of itself, sufficient to hold V_1 at cut-off and to allow the sweep to proceed. The sweep continues until the grid potential of V_3(b) again approaches that of V_3(a) and the cycle of operations is complete.

It will be realized that the fly-back is forcibly initiated and suppressed at instants when the amplitude of the saw-tooth approaches equality with the potentials of E_1 and E_2 respectively, as shown in Fig. 2. In Fig. 3 the difference between these potentials is maintained constant by the gas discharge stabilizer V_6. Owing to the relatively large loop amplifications of the FB_1 and FB_2 circuits, the amplitude of the saw-tooth is closely controlled, and with all ordinary variations to be expected in components, excepting R and C, the repetition frequency changes very little. Normally a linear sweep is required, so that a negative feedback type of constant current charging device (e.g., a cathode follower[1]) is usually substituted for R in Fig. 3. This is much preferable to the more usual pentode, because the current can then be controlled with considerable accuracy. The condenser C—or more usually a succession of condensers to give the required frequency range—must be a stable component; good quality paper condensers have been successfully used for the low frequencies and silvered mica for the high. With such precautions, the frequency controls of the time-base can be calibrated in the confidence that the calibra-

[1] "Electronic Circuitry," Oct., 1949, p. 395.

Fig. 3. Circuit of the stable time-base, with dotted compartments corresponding to the block diagram in Fig. 1.



tion will remain unchanged over considerable periods of time. The main "active" component on which the operating frequency depends is the stabilizer V_4, and a good choice here would be the 85A1.

The time-base may be synchronized by applying a suitable proportion of the waveform under observation to the grid of V_3(a) or to the grid of V_3(b). In the latter case the synchronizing waveform either shortens or prolongs the fly-back time, so that this method is only really suitable when the synchronizing waveform has sharp leading or trailing edges. It is generally much more convenient to synchronize at the grid of V_3(a), and then the onset of the fly-back is either delayed or accelerated. This method is indicated in Fig. 3 by the connections shown.

In most simple time-bases it will be noticed that the onset and cessation of the fly-back is not very rapid compared with the intervening part. In the present time-base the fly-back can be made exceptionally rapid because of the additional loop amplification provided by the FB_1 and FB_2 circuits at the critical "turn-over" points. An additional factor making for a short fly-back time is the fact that it is easy to arrange for the anode potential of V_1 always to be sufficient to enable a large discharge current to be drawn. In fact, it has been found practicable to calibrate the frequency controls on the assumption of zero fly-back time for a 3:1 range between 5 and 15 c/s, and between 15 and 50 c/s; and to adjust C in steps to yield frequency ranges up to 50 to 150 kc/s, with an error nowhere exceeding four per cent. At frequencies above 150 kc/s (or thereabouts, depending on the exact circuit) the stray capacitances begin to exert sufficient influence to render the calibration increasingly inaccurate. Using the valve types shown, a maximum frequency of about 250 kc/s could be obtained with C provided merely by the stray and inter-electrode capacitance, with a charging current of 3 mA, and a saw-tooth amplitude of about 100 volts.

In use the waveform to be observed is applied to the deflection plates of a c.r.t. and to the synchronizing terminals of the time-base. The sync. control is then adjusted to apply the weakest of locking to the time-base, after which the frequency controls are adjusted until a poorly locked trace is seen, and finally the sync. control is advanced until the lock becomes satisfactory. The frequency of the time-base can now be read from the calibrated controls, and the frequency or timing of the waveform under investigation deduced. If the time-base proper is followed by an amplifier of variable gain, the amplitude of the visible sweep on the c.r.t. can be made variable without affecting the frequency calibration. This facility is sometimes useful when it is desired to study a small part of the waveform under investigation.

Finally, it is perhaps worth noting that stable time-bases of this type have been in laboratory use for nearly three years now, and on the whole have proved very useful.

AMERICAN INSULARITY

By O. S. PUCKLE, M.I.E.E.

PROFESSOR MACLAURIN, of the Massachusetts Institute of Technology, has written a most interesting book, "Invention and Innovation in the Radio Industry." It is, however, unfortunate that a large part of the book suffers very greatly from the same fault as that which appears in many American technical writings. I refer to the fact that some American writers appear to play up American achievements at the expense of their scientific and technical colleagues in other parts of the world. A reader of this book who is unfamiliar with the true state of affairs would undoubtedly receive the impression that Europe had contributed nothing to the radio industry since about 1910. This is simply not true.

In dealing with the early days Professor Maclaurin has been eminently fair and reasonable. Why, then, does he find it necessary to write in so biased a manner about later happenings? One can only assume that his reading of the later happenings has been solely from American magazines and technical journals, which also suffer from this defect. These journals are read in Europe because the Americans have done, and are doing, much to help the radio industry, but they have certainly not done everything. I should add that the most important American scientific journals do not indulge in this practice.

In the field of inventions outside America, the following facts and inventions deserve a place:—

(1) Professor Sir Ambrose Fleming's work on the valve is made to appear unimportant, whereas it is the basis on which the whole of the radio industry is built.

(2) Great Britain produced the first successful high-definition television service in the world and the quality of the results obtained in this country are considerably better than those obtained anywhere else, not excluding America.

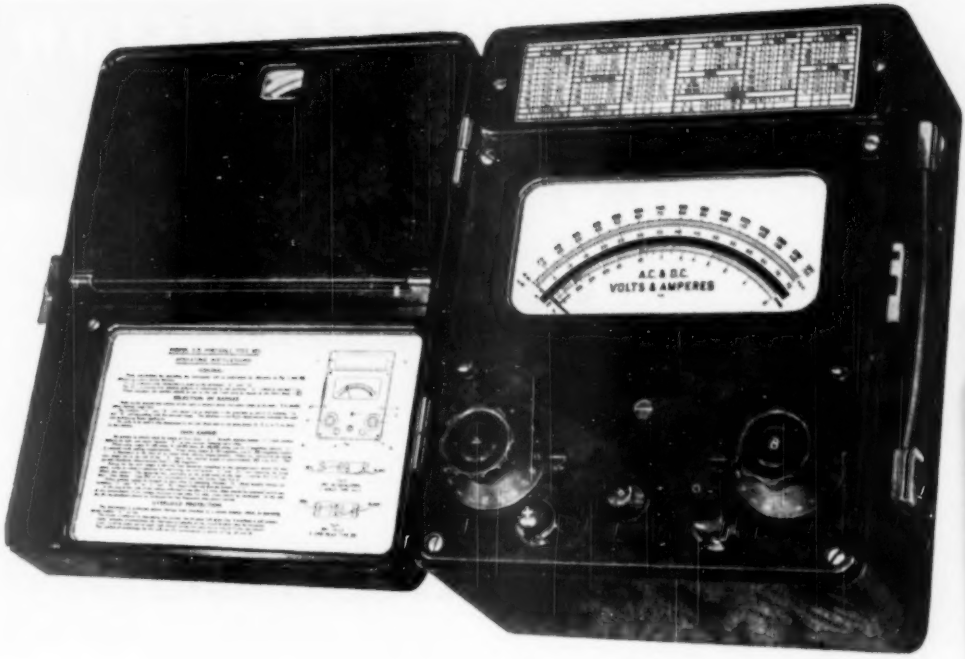
(3) Great Britain first developed radar and is certainly not lagging behind America at the present day.

(4) The wartime work of A. D. Blumlein and F. C. Williams on circuitry in this country deserves notice since it is of the greatest possible importance, and the same may be said of the work of Randall, Boot and Megaw on the high-power magnetron, which at once made centimetric radar practicable.

I could enumerate many other examples, but these will suffice.

It is to be hoped that, in future, American writers will be rather less insular in their outlook and more willing to credit the foreigner with a certain amount of inventive ability. European engineers have a great deal of admiration for the work being done in America and they do their best to give them credit for all they have done when writing books or technical articles.

With the proviso stated above, I should like to say that, in my opinion, this book is of the very greatest interest and well worth reading. There is no doubt that Professor Maclaurin has done a useful job in publishing this book and I would like to suggest that he could do even better by immediately writing a second edition in which, to European eyes, the bias is less noticeable.



The WESTON S.75 Multi-Range Test Set

53 Ranges with Rotary Switch Selection

This uniquely comprehensive Test Set has 53 ranges for measuring AC and DC current and voltage, resistance and insulation. It is completely self-contained, with internal batteries to provide power for the ohms ranges and self-contained power pack for insulation measurement at 500 v. Selection is carried out by two 20-position switches. A fully protective safety device is fitted and is operative for forward or reverse overload. The 150 division 6″ scale is uniformly divided and is fitted with an anti-parallax mirror. The set is enclosed in a handsome bakelite case and fully complies with B.S.S. No. 89 covering first grade instruments. Full details of this, and other Weston electrical measuring instruments will gladly be supplied on request.

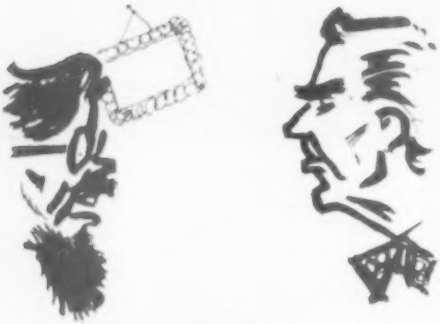
SANGAMO WESTON LIMITED

ENFIELD, MIDDLESEX

TELEPHONE: ENFIELD 3434 (6 LINES) AND 1242 (4 LINES)

AREA DEPOTS:

201 St. Vincent Street, Glasgow.	*Central 6208*
Milburn House, Newcastle-on-Tyne.	*Newcastle 26867*
22 Smith Street, Manchester.	*Central 7904*
33 Princess Street, Wolverhampton.	*Wolverhampton 21912*



R.A.'s may wrangle

. . . . But painters are practical men - they use paint (which has been electrically charged) to spray Industrial equipment without wasting a splutter.

That Parmeko Transformers are used in this equipment to obtain better results is not surprising: for Parmeko Transformers are designed by people devoted solely to that task; produced on single-purpose plant, and used by most of Britain's largest manufacturers.

PARMEKO of LEICESTER

Makers of Transformers for the Electronic and Electrical Industries

TELEVISION -WELL PAID OPPORTUNITIES

- See "Situations Vacant" in this and other journals.
- We receive daily enquiries from employers for our students.

Write to-day for our FREE BOOKLET giving full details of all DAYTIME and POSTAL COURSES.

Write to Dept. 16

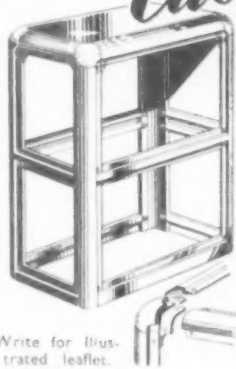
E.M.I. INSTITUTES

10 PEMBRIDGE SQUARE, NOTTING HILL GATE, LONDON W.2. TELEPHONE: BAYSWATER 5131/2

Associated with "H.M.V." MARCONIPHONE COLUMBIA ETC

1.3

A Pre-Fab Cabinet



Widney - DORLEC REGD CABINET SYSTEM

providing an easily constructed cabinet for manufacturers and laboratories. The range of extruded sections, corners and brackets now available enables a housing for individual designs to be easily erected.

Write for illustrated leaflet.

Technical & Sales Agent

C. H. DAVIS
59, BROMPTON RD. LONDON, S.W.3

Widney PRODUCT

ESTABLISHED 1898

MANUFACTURERS

HALLAM SLEIGH & CHESTON LTD
WIDNEY WORKS · BIRMINGHAM 4

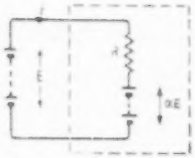


Fig. 1. This circuit is used to illustrate the calculation of resistance.

Negative Feedback

Its Effect on Input Impedance and Distortion

By E. GRIFFITHS, Grad.I.E.E.
(*Engineering Division, B.B.C.*)

READERS of *Wireless World* will be familiar by now with the use of negative feedback to modify amplifier gain and distortion characteristics. Articles have also been published on the effect of negative feedback on output impedance, but very little has been written about the modification of input impedance by negative feedback, although it has been mentioned in passing by several authors. In this article the spotlight will be concentrated on the way in which negative feedback can be used to change the input impedance of an amplifier.

First, however, it is necessary to clear our minds of the idea that resistance as measured in ohms always indicates the presence of a physical component of that value. We are so used to handling resistors marked or colour-coded in ohms that it is easy to forget that resistance is a ratio of two in-phase quantities, voltage and current, and that the input impedance of a circuit is defined as the ratio of the voltage across the input terminals to the current flowing into the terminals. As an example, consider a mysterious black box with two terminals. If a p.d. of 2 V across the terminals causes a current of 1 A to flow, the obvious conclusion is that there is a 2-Ω resistor connected between the terminals, but this does not necessarily follow. There might be a 1-Ω resistor inside the box with a 1-V battery opposing the applied e.m.f., or on the other hand, it could be a 3-Ω resistor in series with a 1-V battery aiding the applied e.m.f. If different applied voltages were tried we might conclude that there was a non-ohmic resistor inside the box, because the applied e.m.f., divided by the current flowing, would not be a constant. After a while, however, suspicion might be aroused and a voltmeter connected across the input terminals would give the answer to the problem. Suppose, however, there was a gremlin inside the box who adjusted the internal e.m.f so that it was always proportional to the applied e.m.f. Where would we be then? The voltmeter test would show nothing, but it is obvious that the input resistance would not be equal to the value of the physical resistance inside the box.

Using the symbols shown in Fig. 1 we can calculate the input resistance as follows:

Net voltage acting round circuit

$$= E - \alpha E$$
$$= E(1 - \alpha)$$

hence

$$i = E(1 - \alpha)/R$$

so that, input resistance

$$= E/i = R/(1 - \alpha)$$

which is greater than R.

On the other hand, if the gremlin suddenly reversed the polarity of the internal e.m.f., the input resistance would fall to $R/(1 + \alpha)$.

After this slight digression we can now return to the object of this article and consider how the input impedance of an amplifier can be increased or decreased, depending on the method of connection of the feedback voltage.

With series-connected feedback the source voltage, grid voltage and feedback voltage are in series round the circuit. Fig. 2 shows the simplified circuit for an input stage with valve gain A, connected to a source of internal resistance R_1 and open-circuit output voltage e'. Assuming a grid-cathode voltage of e_g is developed across the grid resistor R_2, the output voltage will be Ae_g and, if the feedback voltage is fed back via a circuit of gain β', the feedback voltage will be $A\beta' e_g$. (It will be seen later why β' is used in preference to the usual symbol β).

By definition, the input impedance $Z_i = e/i$ and

$$e = iR_2 + A\beta' e_g$$

but

$$e_g = iR_2$$

$$\therefore e = iR_2 + A\beta' iR_2$$

whence

$$Z = e/i = R_2(1 + A\beta') \quad \ldots \quad \ldots \quad \ldots \quad (1)$$

and shows that the input impedance has been increased by the use of series-connected feedback.

Parallel-connected feedback is obtained when the three voltages in which we are interested are connected in parallel, as shown in Fig. 3. The feedback voltage is aiding the input voltage and the grid-circuit current is therefore increased—the input

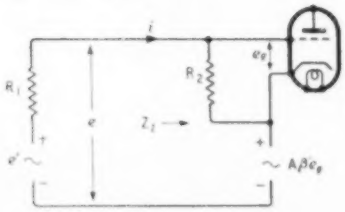
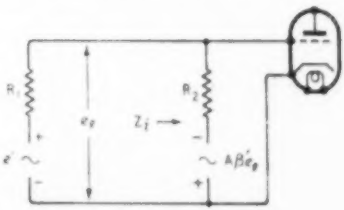


Fig. 2. (left) Showing the simplified circuit of a series-connected feedback stage.

Fig. 3. (right) Illustrating the basic parallel-connected feedback stage.



impedance is thus reduced by the application of the feedback voltage.

With this circuit the input voltage is equal to the grid voltage, so that the input impedance is given by:

$$Z_i = e_g/i$$

and

$$e_g = iR_2 - A\beta' e_g$$

from which, with a little mathematical juggling, we find:

$$Z_i = R_2/(1 + A\beta') \quad \ldots \quad (2)$$

Modern high gain a.f. amplifiers normally use a r.f. pentode for the first stage, and with such valves the maximum recommended value of grid resistor is usually of the order of 0.5 MΩ. When a crystal microphone or pickup is used, it may be desirable to use a much higher input impedance than this, and a series-connected feedback stage may then be used as a half-way house between a conventional valve stage and a cathode follower.

As an example, consider the requirement of a 5 MΩ input impedance when the grid resistor is 0.5 MΩ. The increase in input impedance required is 10 times and reference to equation (1) shows that the required value of $A\beta'$ is 9. Assuming a grid to anode gain of 200 is available, calculation shows that β' is 9/200. Fig. 4 then gives the circuit to be used. The load resistance for the valve (R) is that of the anode feed resistance R_2 and the following grid resistance R_3 in parallel and a typical value is 100 kΩ. β' is the ratio of the feedback resistance to the load resistance, and since this must have a value of 9/200, the correct value for the feedback resistance R_1 is 4,500 ohms.

Parellel-connected feedback may be used to give feedback without loss of gain, provided that the comparison is made on the basis of two amplifiers doing the same job. By this, it is meant that the comparison is between two amplifiers having the same input impedance, rather than the same amplifier with and without feedback.

Fig. 5 shows an example of parallel-connected feedback. In this circuit the value of the grid resistance is not limited by the maker's recommended value, since there is a low resistance d.c. path between grid and cathode provided by the input transformer. If the resistance R_4 is made 5 MΩ and the impedance on the secondary of the input transformer is to be 0.5 MΩ, reference to equation (2) shows that $A\beta'$ must be 9 and hence, with a grid to anode gain of 200, β' is 9/200. Assuming a value for R_1+R_2 of 0.3 MΩ we have:

$$\frac{R_2}{R_1+R_2} = \frac{9}{200}$$

and hence, $R_2 = 13{,}500$ ohms.

The Feedback Factor

It is now necessary to distinguish between β and β'. In this article, β' has been defined as the ratio of the fed-back voltage to the output voltage. β is, however, defined by the fact that $A\beta e_g$ is the feedback voltage effective between grid and cathode. This distinction is made clear by reference to Fig. 6

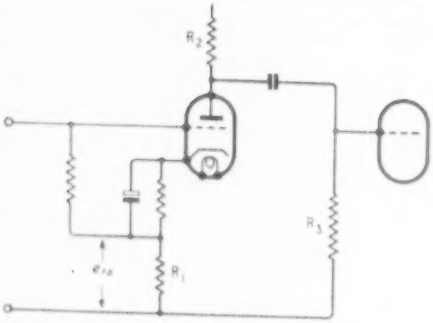


Fig. 4. Cathode feedback is one example of the series-connected type.

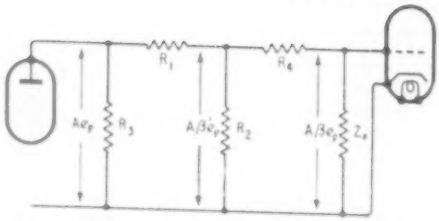


Fig. 6. This diagram is used to show the distinction between distortion reduction and gain reduction factors.

Fig. 5. Illustrating parallel-connected feedback with transformer input.

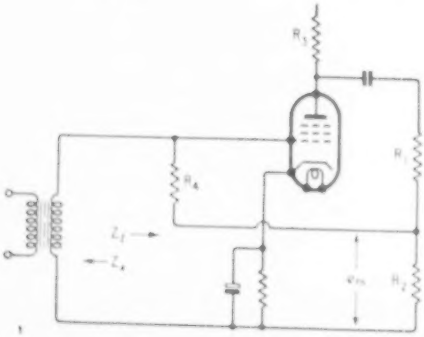
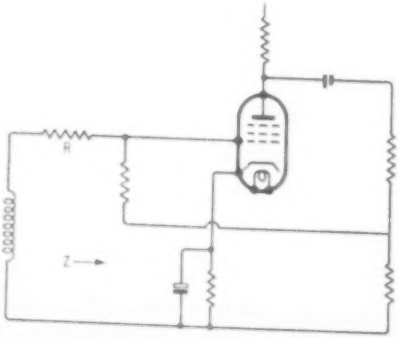


Fig. 7. This arrangement enables distortion to be reduced more than with the circuit of Fig. 5.



which is equivalent to Fig. 5 when only the feedback path is considered. The distortion-reduction factor when negative feedback is applied to a single-stage amplifier is $1/(1+A\beta)$, but the value of β' must not be substituted in this formula, since it is not the voltage $A\beta' e_g$ which is effective between grid and cathode, but $A\beta e_g$. As an example, considering the circuit shown in Fig. 5 again, we know that the resistance R_4 is 5 MΩ and β' is 9/200, and assuming that $Z_s = Z_4 = 500{,}000$ ohms, and remembering that R_2 is small:

$$\beta = \frac{Z_s}{R_4 + R_s}\beta' = \frac{0.5}{5.5}\beta' = \frac{1}{11}\beta' = \frac{9}{11 \times 200}$$

The distortion-reduction factor with this circuit is therefore:

$$\frac{1}{1+A\beta} = \frac{1}{1+\dfrac{200 \times 9}{11 \times 200}} \approx \frac{1}{2}$$

This circuit can therefore be used to give nearly 50% decrease in distortion without loss of gain as compared with an amplifier without feedback and with the same input resistance. The greater the change in input impedance with feedback, the nearer the distortion-reduction factor approaches a half.

This particular change in harmonic distortion is, of course, only obtained with amplifiers in which a high input impedance is reduced to the same value as the source impedance by the use of parallel-connected feedback. When the source impedance is high compared with the input impedance obtained by applying feedback the distortion will be reduced by more than 50%, because β more nearly approaches β'. The converse also applies.

When a greater reduction in distortion is required it can be obtained by using the circuit of Fig. 7. This circuit may be developed from that of Fig. 5 in the following manner. If β' is increased the value of the impedance Z will fall. The input impedance may be restored to its original value by adding the resistance R, the effective feedback factor then becomes larger, so that the distortion is reduced still more. On the other hand, the series resistance R and the apparent impedance Z, together, form a voltage-dividing network, so that the gain is reduced by the factor $Z/(R+Z)$. When cathode injection of the feedback voltage is used, the gain is reduced by the same factor as the distortion (for a given output) but when parallel-connected feedback is used the required reduction is distortion can be obtained with only about half the loss in gain that is given by the more conventional circuit.

Gain Stabilization

One advantage of negative feedback is that the overall gain is stabilized in spite of reasonable variations in valve parameters. When parallel-connected feedback is used, an easily visualized explanation for this exists. If the grid to anode gain falls, the input impedance rises and with the simple circuit shown in Fig. 5 a bigger proportion of the source voltage appears between grid and cathode. With the circuit of Fig. 7 the loss ratio of the voltage-dividing network falls, owing to the rise in the value of Z, but in this case the variation in amplifier input impedance is less, because of the padding effect of the series resistance R.

OPERATING TROLLEY-BUS POINTS

Remote Control from Driver's Cab by Induction Link

SINCE the introduction of trolley-buses in London, one of the main operational difficulties has been the changing of points on the overhead track at junctions and turning places. At present, this has to be done either by the conductor, who leaves the bus to operate a switch at the side of the road, or, in the case of a busy junction, by a man permanently on the site. To overcome the many obvious disadvantages of this procedure, a device has now been developed by Wayne Kerr for the London Transport Executive, to enable the trolley-bus driver himself to change the points by pressing a button in his cab.

It is an induced-current system, comprising a one-valve oscillator and transmitting loop on the trolley-bus, and a corresponding pick-up loop and receiver mounted on the overhead track wires. The driver switches on the oscillator as he approaches the junction, then as soon as the transmitting loop on the roof of the trolley-bus passes underneath the pick-up loop, a current is induced from one into the other. This is rectified in the receiver, and the resulting d.c. operates a sensitive relay which, in turn, closes the electrical circuits of the existing point-changing mechanism. To switch on the oscillator, the driver presses a push-button which actuates a thermal relay to give a 30-second time delay; this enables him to put the system into operation some way in advance of the junction, and so leaves his hands free for driving for the rest of the time. A signal is painted on one of the roadside pillars to tell him exactly when to press the button.

Since the transmitter radiates at a frequency of 70 kc/s (somewhere in the region of 4,000 metres) it is not likely to cause interference with reception on the long-wave band. In any case, the power radiated has been deliberately kept low in order to limit the range of the system to a few feet, so that the receiver will not be triggered by more than one transmitter at a time. The oscillator valve dissipates about 12 watts in its anode, and the tank circuit is matched to an 80-ohm coaxial line which feeds power into the transmitting loop. Heater current for the valve is obtained directly from the 24 V supply in the trolley-bus, and h.t. from the same source by means of a synchronous vibrator.

Perhaps the most interesting part of the equipment is the receiver. This consists of little more than a 5-mA Westinghouse bridge rectifier housed in a small container, which is suspended, together with the pick-up loop, on the overhead track wires. The d.c. output of the rectifier is wired across to a roadside pillar and into a weather-proof box, which contains the sensitive relay already mentioned and a heavier relay for switching the point-changing mechanism. The pick-up loop is arranged in a rectangle, 16ft × 5ft, and consists of one turn of 3-core electric light cable, with the cores connected to form three turns.

Reports from the London Transport Executive indicate that the first installation, at a road junction in Croydon, has proved very reliable and simple to operate, and four trolley-buses have, so far, been equipped with transmitters.

UNBIASED

By FREE GRID

Quicunque Vult

MOST of you have, I suppose, heard the story of the youthful and impecunious curate whose wife unexpectedly presented him with twins when he had budgeted for only one child. With a grim and determined expression on his face he promptly named them Alpha and Omega. To the unlettered masses such names may appear to be meaningless and to have no bearing on the matter, but *W.W.* readers and other *alumni* of Robert Rankes will have no difficulty in recalling the succinct definitions of "the first and the last" given to these two letters in the Apocalypse.

I cannot help feeling that the + and − signs with which we continue to label our cells and the d.c. parts of our radio circuits are equally as meaningless to non-*W.W.* readers. Many a listener whose electrical education hasn't advanced greatly since the last century probably imagines that one sort of electricity comes out of one battery terminal and another out of the other. A more technically advanced citizen would speedily point out, with all the dialectical skill of a well-fee'd lawyer, that there was only one kind of electricity, which, like the cornet music in the once-popular song, "goes round and round." We could pardon him for thinking that there was an excess of electrons at the + terminal and a deficiency at the − terminal so that the battery tried to adjust itself around the external circuit in the seemingly commonsense way.

But all *W.W.* readers will know on the authority of "Cathode Ray" and myself (15th December and 3rd November, 1948) that electrons dwell in Looking-Glass land like the friends of Alice and therefore go the wrong way round like a woman driver negotiating a traffic roundabout. "Lesser breeds without the law," gorged by a surfeit of "Explaining-The-Atom" articles which are dished out daily nowadays and bewildered by much talk of protons, positrons and neutrons, in addition to electrons, might well be forgiven for postulating a four- or six-times fluid theory.

Surely the best way of settling all this business is to cease using the misleading + and − signs and to leave such symbols to the nuclear physicist if he wants them. The obvious name for the so-called negative terminal of a cell is cathode terminal, the anode being the so-called positive. In this way we should avoid the hopeless befogging of the lay mind that exists at present and bring things into line with the nomenclature used in the field of the valve and the c.r. tube.

"Cathode Ray" may care to support my plea, although I always fancy he regards me as a bit of an Arian, and he may, therefore, denounce my ideas with Athanasian thunder.

The Cloven Hoof

THE *Journal of the Franklin Institute* contains, as one would expect, much of value to electrical and radio engineers. A recent issue also contains something suggestive of Berchtesgarten rather than Philadelphia. An Editorial scribe demands with totalitarian abruptness that the scientist be subject to the authority of no man, but that he be allowed to carry out his heart's desire, namely, research work, untrammelled by such sordid things as money, and the restrictions which the lack of it forces upon him.

Here let me interpose that this sort of world is the one I've always wanted for myself, and so have you, too, if you are honest with yourselves; in brief, a worryless world. But, unfortunately, the curse laid upon Adam—and I'm not referring to Eve—still holds good, and we can't expect the community to keep us while we let our ego fulfil itself.

The Wrong Way Round.

Now it doesn't at all surprise me that the writer goes on to attack Hitler and St. Paul, among other figures who have been prominent in the world's history. Some scientists always attack Adolf because, I suppose, in his heyday he achieved a

The Curse of Adam.

goodly measure of success in applied psychology, so far as the German people were concerned, although he had no book learning in the matter. To a scientist, lack of book learning is one of the unforgivable sins. It doesn't take a very long memory to recall the frowns bestowed on young Marconi who, although not claiming to be a scientific savant, managed to bridge the Atlantic in 1901 without ever having heard of the Heaviside layer.

If a scientist holds the technocratic and therefore virtually totalitarian views which the Franklin *Journal* writer voices, then there is an even greater sin than lack of book learning, and that is for an aggressor to see the error of his ways and join the opposite camp. Those of you who have rather more accurate knowledge of St. Paul than to imagine that he built the Cathedral on Ludgate Hill, will recollect that this is exactly what the man of Tarsus did. Few people have persecuted a religious community with more fervour than he did, and it is not surprising, therefore, that when he suddenly abandoned his old ways he incurred the undying hatred of his former fellow-aggressors.

Since that day his memory has always been to the aggressor, potential or actual, a sharper and more piercing "thorn in the flesh" than that from which he himself suffered. If the opinions of the Franklin *Journal* writer be any criterion, it is clear that the passing of the ages has not blunted it by one decibel or whatever be the unit of acuity.

LETTERS TO THE EDITOR

The Editor does not necessarily endorse the opinions expressed by his correspondents.

"A.C./D.C.-Battery Power Supplies"

THE article by L. Miller in your January issue contains several serious errors, presumably caused through lack of knowledge of the characteristics of the battery valves concerned.

In his third paragraph, Mr. Miller refers to "... 1.5V and 3.0V valves ..." In fact, the rating is 1.4 and 2.8 volts both in England and America. This rating is, however, only used when the valves are run from a dry cell of the Leclanche type, whose discharge characteristic shows a progressive fall in voltage during life. When the valves are run from a constant voltage source, as is the case when mains-operated, it is desirable to maintain the filament voltage at 1.25 volts, 46 mA, in order to combine a long life with adequate performance.

The supply voltage, therefore, for a set of four valves, when mains operated, would be 6.25 volts (3×1.25 and 1×2.5) and not 7.5 volts as stated by Mr. Miller. If continuous operation at the higher voltage is attempted, an unnecessarily short life will be experienced.

The suggestion that a 50L6 be used is still applicable if the correct operating current for the battery valves is employed, by increasing the grid bias voltage by means of a cathode resistor.

The circuit shown in Fig. 3 is unlikely to be satisfactory, since the screen voltage is presumably left connected to the battery output pentode when the mains valve is in use, although the anode voltage is disconnected. Furthermore, the signal voltage is still applied to the control grid.

G. R. WOODVILLE.
The M.O. Valve Co.,
London, W.6.

IN view of some of the remarks in L. Miller's article in the January issue, we feel that we should draw your attention to our published operational recommendations for the use of "1.4-volt" valves, the relevant sections of which are:—

"(1) *Dry Battery Operation.* Valves with 1.4-volt filaments are designed to be operated from a dry-cell battery with a rated terminal voltage of 1.5 V. In no circumstances should the voltage across any 1.4-volt section of filament exceed 1.6 V. If these valves are operated with their filaments in series from dry batteries with a higher terminal voltage, shunting resistors may be required to ensure the correct voltage across individual 1.4-volt filaments.

(2) *Accumulator or Mains Operation.* When valves with 1.4-volt filaments are operated from an accumulator or from a mains supply unit, the voltage drop across each 1.4-volt section of filament of valves with rated filament current should have a nominal value of 1.3 V and should be maintained between 1.25 V and 1.4 V at normal line voltage, that is to say at voltages equivalent to 2 volts per cell for accumulators or to nominal line voltage for supply mains. If the filaments are operated in series, shunting resistors may be required to ensure the correct voltage across individual 1.4-volts filaments."

Although in paragraph (1) a rated *terminal voltage* of 1.5 V per cell is quoted, it must be borne in mind that the average potential per cell during most of its useful life is approximately 1.3 V.

From paragraph (2) it is apparent that the filament voltage should not be adjusted to a nominal value of 1.5 V when the filaments are operated from a mains supply.

The shunting resistors referred to in the final sentence are necessitated by the fact that the anode current of each valve flows through the filaments of all valves nearer the negative end of the filament chain, and the cumulative anode current near the negative end of the chain is sufficient to overload the filaments.

The upper and lower limits for the filament voltage (1.4 V and 1.25 V) are specified to permit correct l.t. adjustment with the minimum number of input tappings on the mains transformer, and also to permit convenient values of shunting resistors to be employed.

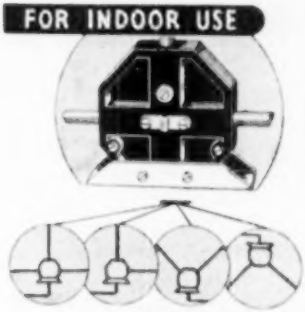
It must also be understood that the rated filament current of 50 mA occurs only at a filament voltage of 1.4 V; at 1.3 V the filament current is less, a typical value being 47 mA.

The method of operation described by Mr. Miller in which the filament chain of the battery valves is in the cathode return of a mains output valve, cannot be recommended as satisfactory for use in

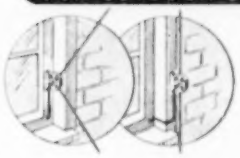
ANTIFERENCE 'Fourway'

The
VERSATILE
TV AERIAL for
STRONG SIGNAL AREAS

FOR INDOOR USE



FOR OUTDOOR USE



WHEREVER signal strength permits the use of an indoor aerial, the "FOURWAY" has proved itself by fulfilling every demand of the most critical. Its adaptability to widely varying structural requirements enables the "Fourway" to be mounted in the loft or unobtrusively in any part of the house. Although originally designed for indoor mounting, the "Fourway" gives even better performance when mounted outdoors (as illustrated) and is the ideal aerial for flat dwellers and those who find that an indoor aerial provides insufficient signal strength. Suitable for use with every type of television receiver and feeder cable.

LIST PRICE
25/-
London Transmission—Mode 4-way I.
Midland Transmission—Mode 4-way II

ANTIFERENCE
LIMITED
67 BRYANSTON ST · LONDON W.1

large-scale receiver manufacture. Normal deviations of the characteristics of the mains output valve from those used in the design of the circuit, and possible variation in the operating conditions during life, might easily result in the filaments of the battery valves being run at a voltage outside the recommended limits. Furthermore in the event of the mains valve passing an abnormally high current, the filaments of some or all of the battery valves would be destroyed.

If, however, there are experimenters who wish to investigate these circuits, may we draw attention to the Mullard UL41 valve? The heater current of the UL41 is only 0.1 A compared with 0.15 A for the 50L6, and it requires a heater voltage of 45. The half-wave rectifier in the Mullard range suitable for use with the UL41 is the UY41, with a heater current of 0.1 A and a heater voltage of 31.

H. P. WHITE.

Mullard Electronic Products,
London, W.C.2.

Stereophonic Broadcasting

A NOTE in your January issue states that "it is understood" that the f.m. transmitter at Wrotham has now been accepted by the B.B.C., and we may therefore deduce that at some future, unspecified date official transmissions will begin.

It is typical, however, of the Corporation's obscurantism in engineering policy matters that we should have to rely on such meagre information on the progress of a fundamental development. Listeners with some technical awareness will not have forgotten the occasion of the change of site of the Third Programme transmitter which, virtually unannounced, caused great inconvenience in much of the London area; nor will they have failed to observe, more recently, the unheralded jugglery with transmitter powers. It is high time that the Corporation recognized its obligation to the technically informed public, for the rapid progress of broadcasting has depended, to a considerable extent, on the active participation of this body in the transitional and formative phases.

I do not believe, however, that the B.B.C. is past praying for; it could easily reverse this baleful trend and restore its position as an enlightened body in the technical as well as the cultural spheres. It might begin, for instance, by sending out binaural transmissions from Wrotham, radiating one channel from the f.m. and the other from the a.m. transmitter. In this way the listeners could judge for themselves the efficacy, or otherwise, of a stereophonic system. Let me attempt to counter, in advance, possible objections which might be raised to this proposal.

(a) Cost. The binaural system could be used on, say, certain selected orchestral programmes originating in the London area; in this way the line costs could be kept to a minimum. The studio costs would be small, and I do not doubt for a moment that the necessary enthusiasm exists in all grades of the B.B.C. engineering staff to carry out such an experiment.

(b) The restricted appeal of such a system. A large number of professional and amateur radio engineers would no doubt welcome such a trial. We might note that Writtle had a restricted appeal in 1920.

(c) Diversion of effort and facilities. The juxtaposition of your January note with another suggests that powerful commercial interests may oppose further expenditure on the f.m./a.m. project. The B.B.C. has usually, in the past, sets its heart against wrong-headed parochialism, however well intentioned, and it can safely be trusted to resist the influence of newer pressure groups.

E. JEFFERY.

Arborfield, Berks.

Television on 25c/s Mains

WITH the extension of the television service to the Midlands area, the existence of a number of pockets of 25 c/s mains will undoubtedly lead to the temptation to use television receivers designed primarily for frequencies of 40 to 60 c/s.

Each individual design of equipment involves certain problems and, in many cases, the addition of several hundred microfarads to the existing smoothing capacitor, whilst yielding a tolerable performance, is not without hazard.

May I suggest that in each case the receiver manufacturer be consulted in advance to ensure that dependable information regarding the modifications required is obtained and carried out, to reduce this hazard to a minimum?

O. G. COX.

A. H. Hunt, London, S.W.18.

Dark Television Screens?

AS the black portions of a television image are due to the non-illumination of the screen by the scanning beam, the depth of "blackness" is determined by any extraneous light which falls on the screen. Hence if the screen itself were initially dark instead of "off white" as at present, considerable improvement in contrast should be experienced when viewing in lighted rooms or in daylight.

It would be interesting to know if it is technically possible to manufacture tubes with dark-coloured screen materials.

A minor advantage would be a more pleasing appearance to the receiver when it is not in use, as the white screen has a very "naked" look.

With regard to title captions, lists of artists, etc., used during television programmes, the general practice seems to be black lettering on a light background. Would it not be preferable to use white lettering on a dark background? This would be more restful to the eye, would prolong tube screen life and would reduce the power used by the transmitter.

If black lettering on a light ground is more practicable on the actual caption card, a "negative" could easily be produced electronically.

ALAN HUMPHREYS.

London, N.4.

"Output Impedance Control"

WHILE it is true that excessive resistive damping applied to a loudspeaker can cause loss of transients, Mr. Roddam (your February issue) is surely at fault in stating this in connection with the effective damping produced by feedback. A low resistance connected across the loudspeaker could produce this effect, but feedback damping works in a different way.

With negative voltage feedback, the amplifier input is the difference between the applied signal and the voltage across the loudspeaker. As the latter is largely dependent on the cone velocity, the feedback tends to make the velocity proportional to the applied voltage.

With no input signal, the feedback loop damps the motion of the cone, since any movement will apply a voltage to the input of the amplifier so that the output stage exerts power to stop the movement. The application of an input signal jerks the cone into motion, the force applied being proportional to the discrepancy between the actual cone velocity and the correct velocity. Increasing the feedback increases the excess power applied, and reduces the discrepancy.

The "swinging door" analogy fails, because in that case the damping is applied continuously in relation to a fixed point. In the feedback amplifier the damping is applied in relation to the instan-

taneous input signal voltage. Transients are improved by the application of excess power on the leading edge and at the peak, while the cone is brought to rest quickly after the transient has ended.

The excess power required must be available, and it may be that this is the source of Mr. Roddam's loss of transients. Taking the output level he quotes, 50 mW, an undamped amplifier will need about 5 watts peak output to deal with transient peaks. With feedback applied, the normal peak margin of 20db must be increased by 5-6db with the average loudspeaker, giving a total power of 20 watts.

It is interesting to note that the extra margin required with a cheap loudspeaker may be as much as 10db, while some of the best types require only 3-4db. These figures apply to a feedback loop giving AB=25. Lesser degrees of feedback require less extra power.

If sufficient reserve power is available, the heaviest possible feedback gives the best result. The practical limit is imposed by stability requirements, and here again Mr. Roddam makes a queer statement. He says that if the feedback is taken too far the amplifier will oscillate, but this effect can be detected by ear. Not if the oscillation is in the supersonic range, as it may well be. Many experimenters have condemned negative feedback because it introduces supersonic oscillations, the only audible effect being a reduction in power output capacity.

The scheme for feeding a varying number of speakers from the output of a heavily damped amplifier must also be questioned. The load impedance will vary, and the matching will suffer. A better system is to use suitable load resistors which are substituted for loudspeakers not in use. The load then remains constant, and so does the power supplied to each listening point.

Lastly, the condition under which a feedback amplifier has a gain of 1/B (more correctly $-1/B$) is that AB is large, not that A alone is large.

Having dealt cavalierly with some of his minor points, I would like to make some amends by congratulating Mr. Roddam on the circuit which forms his main theme. It is good to see something simple and efficient in these days of inefficient complexity.

DONALD W. THOMASSON.
E.A.R.L. Services, Exeter.

Interference from Televisors

ONCE again I write to you concerning a type of interference which is widespread in the London area, though I have read no comments on it. I refer to the severe interference propagated by certain types of televisor.

The interference is manifest by a raw a.c. tone comprising a mixture of 10-kc/s and 50-c/s frequencies together with other mush. This note is imposed upon any strong carrier received by a radio receiver situated within 100 yards or so of the offending vision receiver.

The number of cases I have personally encountered during the past few months lead me to believe that this interference is rapidly increasing. Apparently the a.c./d.c. types of televisor are the main culprits.

Beyond doubt, local televisors are often responsible for complaints of loud hum in broadcast receivers. When testing the vision units for this fault it is in most cases necessary to make sure television transmissions are on, otherwise the interference is at a low level.

In most cases a partial cure can be effected by placing a capacitor across the main input terminals of the video set. However, it transpires that the capacitance is critical. Too much capacitance often increases the radiation.

R. M. STAUNTON-LAMBERT.
London, N.W.6.

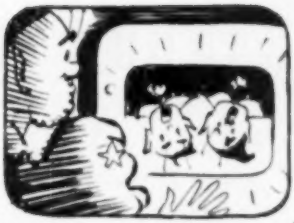
"T-Match Television Aerial"

REFERRING to the article by B. Mayson in your January issue, we are interested, as manufacturers of aluminium alloys, in the material of which the aerial was made. We presume from the context that the alloy used by the author was Duralumin B. This alloy, which is the strongest of the Duralumin series, contains copper, and we would not regard it as specially suited for the construction of a television aerial. We are, in fact, supplying very large quantities of Duralumin H, a strong heat-treatable aluminium alloy not containing copper, for the manufacture of such components, and this alloy has been found to have a strength and corrosion resistance entirely adequate for the service. Aerials made in Duralumin H do not need protection by painting.

We do not normally recommend that, in those cases where aluminium alloys are to be protected by painting, paints containing lead compounds should be used; as in the event of the lead pigment becoming reduced, some harmful effect on the alloy might ensue.

May we add that as the word "Duralumin" is the registered trade mark of this Company, it should be spelt with a capital letter D and not with a small letter.

C. SMITH.
James Booth & Company,
Birmingham, 7.



THE "FLUXITE QUINS" AT WORK

"Our TV will never be right
'Till it's been overhauled with FLUXITE"
Cried the lads from the screen
"It's the worst it's been,
We're all upside down here to-night!"

See that FLUXITE is always by you — in the house — garage — workshop — wherever speedy soldering is needed. Used for over 40 years in Government works and by leading engineers and manufacturers. Of all Ironmongers—in tins, 10d., 1/6 & 3/-.

TO CYCLISTS! Your wheels will NOT keep round and true unless the spokes are tied with fine wire at the crossings AND SOLDERED. This makes a much stronger wheel. It's simple—with FLUXITE—but IMPORTANT.

The FLUXITE GUN puts FLUXITE where you want it by a simple pressure. Price 2/6, or filled, 3/6

ALL MECHANICS WILL HAVE

FLUXITE

IT SIMPLIFIES ALL SOLDERING

Write for Book on the ART OF "SOFT" SOLDERING and for Leaflets on CASE-HARDENING STEEL and TEMPERING TOOLS with FLUXITE. Price 1d. each.

FLUXITE LTD.
(Dept. W.W.), Bermondsey Street, S.E.1

RANDOM RADIATIONS

By "DIALLIST"

European Television Standards

THOUGH BRITAIN and France are the only European countries with regular television services, it is likely that a good many others will enter the field before very long. Everyone realizes the desirability of having a common standard, but it is not easy to find one that is acceptable to all, in fact, the only thing now common to all schemes is the number of frames per second! There's, fortunately, no choice about that, since the mains periodicity in almost all European countries is 50 c/s. A meeting was held in London in January at which the matter of definition standards was discussed by representatives of the five Brussels Treaty countries, Belgium, the Netherlands, France, Luxembourg and Britain. No agreement was then reached, but another meeting will be taking place in Paris by the time this appears in print and it is by no means impossible that these five countries, at any rate, will come to satisfactory terms.

Medium and High Definition

It can't be denied that the difficulties are very great indeed. We cannot possibly change our number of lines, for cast-iron guarantees have been given by the Government that it will be maintained for some years. Few people, except ourselves, regard 405 lines as adequate for the medium-definition service with which most countries will make a start. The standard that seems to be coming most into favour outside the five countries mentioned is 625 lines. Very good results are obtainable with this number of lines, but the modulation bandwidth required is too large for the majority of existing and projected coaxial cables to do justice to long-distance international relays. My forecast is that agreement will not be reached about the number of lines used in medium-definition services. But these, after all, are only a preliminary stage. The television of the future will be the thousand-odd line type and it should be possible to agree on a common standard for this, since no country is yet irretrievably committed to any particular number of lines.

Multum in Parvo

A VERY NEAT little multi-range measuring instrument has been sent to me by a French friend. This is the Model 450 of the well-known Annecy firm, Metrix. Though its dimensions are only $5\frac{1}{4} \times 4 \times 1\frac{1}{2}$ inches it does quite a remarkable number of things—and does them well. Its ranges, 18 in number, are: 1.5, 15 and 150 mA, 1.5A, 15, 150, 300 and 750 V—on both a.c. and d.c.—10,000 ohms and 1 MΩ. The basic instrument is a moving-coil milliammeter with a full-scale deflection at 0.5 A and on all voltage ranges the resistance is 2,000 ohms per volt. The $3\frac{1}{2}$-inch dial has clearly divided scales and an anti-parallax mirror. The makers claim an accuracy better than ±1.5 per cent on all ranges and tests made against sub-standard instruments bear this out. On the 150-V ranges, for example, the greatest error was under 0.5 per cent with d.c. and 1.3 per cent on a.c.

The Range Question

My only criticism of the instrument is one with which by no means every reader will agree. It concerns the actual ranges chosen and I suppose we all have our own ideas about what we like in that way. If I'd had the designing of an instrument with four voltage and four current ranges for a.c. and d.c., I think I should have chosen 3, 30, 300 and 900 volts and for current 3, 30, 300 mA and 3 amps. Then I would have preferred the resistance ranges to be 100,000 ohms and 10 megohms. With those ranges you can make nearly every test on radio receiving gear that can be made with a current-operated instrument. In the old days one never built a set without carefully wishing later on that it contained just one more valve; nowadays I can't handle a multi-range meter for long without yearning for one more range. There isn't room on this little Metrix for the extra socket that would be needed, but perhaps the makers may produce a slightly larger version sometime. If they do, I'd like to see a 0-500 microamp range, making use of the basic milliammeter without any shunt. Should I be satisfied then? I should probably soon discover another that I wanted.

Simple but Useful

TALKING OF METERS, there's one type very useful for certain jobs which can be made up without much trouble from the bits and pieces that most of us have in drawers and cupboards. This is a simple form of slide-back valve voltmeter which will measure r.f. and a.f. voltages. Ingredients: a valve, a milliammeter, a d.c. voltmeter, a potentiometer, two 0.1 μF (or thereabouts) capacitors and a resistor of about 2 MΩ. The choice of the first four components will depend upon the magnitude of the voltages that you want to measure. One of the input terminals is connected to the cathode; the other is connected via one of the capacitors to the grid. Put the resistor between the grid and the slider of the potentiometer, the fixed portion of the potentiometer being connected across a grid biasing battery—the e.m.f. of which again depends on the sort of voltage to be measured. The voltmeter goes between the slider and g.b. + and is shunted by the second capacitor. The milliammeter is arranged so as to measure the anode current. The principle is simply that the valve is biased back to begin with by moving the potentiometer slider until the anode current is zero. The voltmeter reading is now noted as V_1. Next the alternating or oscillating voltage to be measured is applied to the input terminals and the slider of the potentiometer is once more adjusted to make the anode current *nil*. Read the voltmeter again and you have V_2. The *peak* applied voltage is $V_2 - V_1$. To obtain the r.m.s. voltage, if you require it, multiply by 0.707. Thus if $V_2 - V_1$ came to such an obliging—and most unlikely!—figure as 14.14, you would see at once that the applied voltage had an r.m.s. value of 10.

Elbow Room

AS IT HAPPENED, I wasn't able to go to the sort of housewarming party that the B.B.C. gave to inaugurate the new television studios at Lime Grove, Hammersmith, which were bought from the J.

Arthur Rank organization. Next day, though, I met a friend who had been there. He seemed still to be slightly dazed by the vastness of the buildings. "They have bought five great *cathedrals*," he explained. In comparison with the rather cramped accommodation at Alexandra Palace the five new studios certainly are enormous. One of them has a floor area over twice as large as that of the whole studio space at A.P. Between them the five studios at Lime Grove measure some 28,100 square feet, or nearly two-thirds of an acre. The purchase was a wise one, for television plays and so on need many more rehearsals than those for sound broadcasting. Now several rehearsals will be able to go on at once and still leave a studio available for actual broadcasts. The B.B.C. is certainly doing everything it can to help television along. Would that its style were not so cramped by present-day economic obstacles in the way of buying new transmitters and erecting buildings.

MANUFACTURERS' LITERATURE

BULLETIN No. 85, dealing with "Araldite" casting resin, from Aero Research, Ltd., Duxford, Cambridge.

Comprehensive lists of magnetic relays from Jack Davis, 30 Percy Street, London, W.1.

Illustrated leaflets describing radio-frequency heaters Types RFH/1 and EH10A, and waveform monitor, Type 3794, from E.M.I. Factories Ltd., Hayes, Middlesex.

Selected list of test and measuring instruments supplied by F. Livingston Hogg, 77 Wood Vale, Muswell Hill, London, N.10.

Bulletin B60rC, "Phonic Motor Timing Devices," from Muirhead and Co., Beckenham, Kent.

Catalogue of "Reesound" chassis, components and accessories, from the Reesound Engineering and Electrical Company, Coleshill Road, Sutton Coldfield, Warwickshire.

Technical specification, including response curve, of the "Concentric Dual" loudspeaker, from Sound Rentals, Canterbury Grove, London, S.E.27.

New pamphlet of "Telcon" cables for car radio, anti-static and television aerials, and microphones, from the Telegraph Construction and Maintenance Company, 22 Old Broad Street, London, E.C.2.

Retail list of radio components from M. Watts and Co., 8 Baker Street, Weybridge, Surrey.

★ Price 1/- post free

from the Bulgin CATALOGUE

LIST No. T.20, mounting strip with silver-plated tags and brackets fitting, spaced ½in. on ⅞in. wide bakelite strip, for 250-500V. working. One of very many types.

LIST No. D.630, new plug-in-to-chassis plastic insulated M.E.S. lamp holder. Sold unassembled, ready for wiring connections.

LIST No. T.35. Useful flex wire, or cable connector, fitted with 4 B.A. screws at ½in. spacing. Plated metal parts, and best bakelite insulation.

LIST No. D.9, signal lamp, low-voltage, for 10-12mm. ϕ M.E.S. bulbs; max. 1A. 2W. Bezels and "lenses" in a wide range of brilliant colours.

LIST No. P.444. BULGIN ignition-interference suppressors incorporate wirewound resistor, are unbreakable, permanent, and oil-and-water-proof. Plug-in version.

LIST No. P.445. As above, screw-in version.

LIST No. M.P.1-3. Push switches, with Nickel-Silver or Silver contacts, and polished ennoid ½in. dia. buttons in RED, BLACK, or WHITE. For 3A. max. @ 0.1V. min.; 24V. max.

LIST No. S.377, a famous 2-pole M.-B. moulded-structure appliance switch, for 12 A. @ 6V., to 6A. @ 250V. Here shown with **Pt.6363** "ON-OFF" silvered-metal escutcheon which can be supplied, extra, if required.

LIST NO. P.164B. "Standard"-type screened Valve-Top Connector, one of many popular types. The cover clips on after wiring connections are made.

LIST No. P.260 Mains Plug and Socket; latter attaches to cabinet back, so that connection is broken when apparatus is opened. Side entry for flex. For 8A. @ 6V., 3-4A. @ 250V., to 1A. @ 500V., max.

LIST No. S.424. This 1-pole C.-O. biased Push switch occupies a min. of panel-space and rear-of-panel depth. From a wide range of 1- and 2-pole ON-OFF and C.-O. Push models, either biased or unbiased. Rust-proofed steel frames. For circuits of 0.01-250V., at 5-0.2A., max., A.C.

WE CAN MEET ANY REQUIREMENTS

A modern, well-equipped Research and Development Section exists at the **BULGIN Factory** to make all types of electronic components to manufacturers' own specifications.
Stampings, plastic mouldings, and over 12,000 piece parts are ready to meet individual requirements.

BULGIN COMPONENTS all have the research of 25 years behind them, and that experience is a guarantee which has made them

"The Choice of Critics"

BULGIN A. F. BULGIN & CO. LTD. BYE-PASS ROAD, BARKING Telephone: RIPpleway 3474 (5 lines)

Manufacturers' Products

New Equipment and Accessories for Radio and Electronics

Ignition Interference Suppressors

TO combat interference with television, car radio and any form of mobile radio on petrol-engined vehicles, A. F. Bulgin and Company, Bye Pass Road, Barking, Essex, have introduced a suppressor incorporating a wire-wound resistance element for inserting in the ignition system. It is intended to fit into the centre contact of the distributor and both screw-in and plug-in types are available. The resistor is totally encased in a slightly flexible polythene moulding which is virtually impervious to moisture and oil.

In the samples examined, the resistor measured 15kΩ and should therefore have negligible effect on the behaviour of the engine. The screw-in fitting is known as the P445 and the plug-in as the P444; each costs 1s 6d.

Disc Seal Triode

AN addition to the Mullard range of e.h.f. valves is a new disc seal triode, the type ME1003. It is indirectly heated and operates at 6.3 V, 1.6 A, and the maximum anode voltage is 500. It will tolerate a peak anode current of 500 mA, with a normal maximum of 200 mA. The maximum anode dissipation with convection cooling is 25 W.

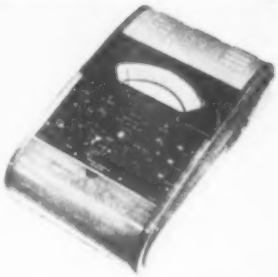
This valve is intended to be used in common grid type circuits in which the anode is "earthy" and in a concentric line oscillator or power amplifier. In a circuit of this kind the power output is approximately 6 watts at 1,500 Mc/s (20 cm), rising to 20 watts at 430 Mc/s (70 cm). The limit of operation is about 13 cm.

The makers are Mullard Electronic Products, Century House, Shaftesbury Avenue, London, W.C.2.

Cabinet Loudspeakers

A SERIES of loudspeakers mounted in acoustically matched vented cabinets has been developed recently by "Phase-In" Speakers, 99, Ash Bank, Bucknall, Stoke-on-Trent. A special feature is the provision of vertical plywood strips in front of the loudspeaker aperture to diffuse the h.f. beam horizontally.

The "Junior" model is supplied with the Wharfedale "Golden" or the type W10/CSB unit at £13 13s or £16 16s and measures 30in × 15in × 12in. In the "Senior" model the width is increased to 17in and the driving units supplied are the Barker 148A, Goodmans Axiom 12 or 22, or the Wharfedale W12/CS, the prices being £28 7s, £21, £25 4s and £19 19s respectively. Finally there is the "Twin" model containing the Wharfedale W10/CSB and W12/CS units with a cross-over network centred on 1,000 c/s. This loudspeaker costs £30 9s and is housed in a cabinet measuring 36in × 18in × 14in. All models have a nominal input impedance of 15 ohms.



Electronic Instruments' Model 25 laboratory valve voltmeter. The meter scale length is six inches and an anti-parallax mirror is provided.

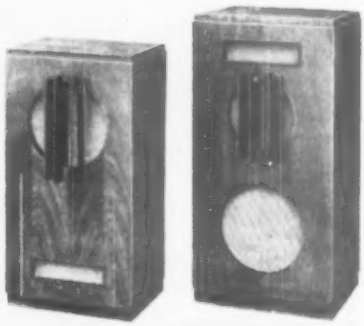
Precision Valve Voltmeter

DESIGNED to give a performance comparable with that of British Standard Specification BS89:1937 for first-grade moving-coil meters, the Model 26 laboratory valve voltmeter made by Electronic Instruments, 17, Paradise Road, Richmond, Surrey, has an accuracy better than ±1 per cent of full scale on all but the two lowest a.c. ranges (where the maximum error does not exceed 2½ per cent), and a stability of 0.7 per cent on d.c. and 0.8 per cent on a.c. ranges over a 24-hour period after warming-up.

Two double-stage d.c. amplifiers are coupled back-to-back to form a balanced bridge network and heavy negative feedback is applied over the whole system; individual range adjustment is effected by incremental variation of feedback. The power supply, which is derived from a.c. mains is stabilized by a constant-voltage transformer. Power consumption is 30 watts.

For high-frequency measurements a probe is provided and is housed in a compartment with a curved hinged flap. Terminals are also provided for low-frequency work, but when these are used the input capacitance is increased from 6 to 30pF.

There are six ranges for both a.c. and d.c. with full-scale readings of 1, 2½, 10, 25, 100 and 250 volts; resistances between 500Ω and 500MΩ can also be read in four overlapping ranges. The price is £88.



(Left) Bulgin car ignition suppressors to combat interference to television and to radio reception on vehicles.

(Bottom left) Mullard disc seal e.h.f. triode type ME1003, for use up to about 2,300 Mc/s (13 cm).

(Below) Junior and Twin "Phase-In" loudspeakers.

BRITAIN'S BEST AUDIO AMPLIFIER

The amplifier whose PERFORMANCE FIGURES have been CHECKED and SUBSTANTIATED by the

NATIONAL PHYSICAL LABORATORY

TESTS OF TL/12 12 WATT AMPLIFIER

	H. J. LEAK & CO. LTD. REPORT		N.P.L. REPORT	
TEST CONDITIONS.	The following are the "pass" figures on final test of amplifiers carried out in our own laboratory. They are the performance figures advertised in preceding issues of the "Wireless World."		In all cases the input was applied to a 50,000Ω resistor connected to the amplifier by 3 feet of screened cable. The output load was in all cases a resistor of 18Ω and the output transformer secondary windings were connected for the "15Ω–20Ω" condition.	
HARMONIC DISTORTION.	0.1% for 10 watts output at 1,000 c/s. 0.19% for 10 watts output at 60 c/s.		0.03% for 10 watts output at 1,000 c/s. 0.1% for 10 watts output at 60 c/s.	
HUM AND NOISE.	− 80 db. referred to 10 watts.		− 80 db. referred to 10 watts.	
SENSITIVITY. Input required for 12 watts output at 1,000 c/s.	160 mV.r.m.s.		148 mV.r.m.s.	
LOAD DAMPING FACTOR. (Load impedance/output impedance.) For 10 watts output at 1,000 c/s.	20.		42.	
FREQUENCY RESPONSE. Gain relative to that at 1,000 c/s. measured at 7.5 watts.	c/s. 20–20,000	db. ± 0.1	c/s. 20 60–1,000 5,000 10,000 15,000 20,000	db. + 0.1 0 − 0.1 − 0.3 − 0.4 − 0.7

NOTE: the N.P.L. figures for frequency response include the losses introduced at the higher frequencies by the capacitance of the input cable shunting the input resistance of 50,000Ω.

TL/12 12 WATT AMPLIFIER Price £25.15.0 RC/PA REMOTE CONTROL PRE-AMPLIFIER Price £6.15.0

Used with the RC/PA pre-amplifier and the best complementary equipment the TL/12 power amplifier gives to the music-lover a quality of reproduction unsurpassed by *any* equipment at *any* price. It is designed in a form so that the power amplifier can be housed in the base of a cabinet and the small pre-amplifier mounted in a position best suited to the user.

★ If you are interested in high-fidelity reproduction or recording you are certain to find our 16-page illustrated booklet of considerable value. It is presented in a form acceptable both to the professional communications engineer and to the amateur enthusiast seeking the highest possible quality of reproduction. ★

WRITE FOR BOOKLET W/TL/12

H. J. LEAK & CO. LTD. (Est. 1934)

BRUNEL ROAD · WESTWAY FACTORY ESTATE · ACTON, W.3

Phone: SHEpherds Bush 5626. Telegrams: Sinusoidal, Ealux, London. Foreign: Sinusoidal, London.

CLYDESDALE

Bargains in Ex-Services Radio and Electronic Equipment

Ex Royal Navy.
SOUND POWERED TELEPHONE.

Requires NO batteries, and will give long service without attention. Complete with warning indicator lamp and generator, giving a high pitched note which can be heard through any noise. Where a number of telephones are used, the indicator lamp would indicate which one is being called. Dim. —7½ x 9 x 7½ins. for wall mounting. Designed for ships' use, but can be used in the home, office or factory.

CLYDESDALE'S PRICE ONLY 27/6 each. CARRIAGE PAID

Ex Canadian Army.
SUPPLY UNIT RECTIFIER, FOR No. 43 TRANSMITTER.
Input 110 v. A.C. 50 cs.
H.T. outputs 2,100 v. 375 ma., 500 v. 400 ma., 450 v., 275 v. Bias 275 v., 250 v., 150 v., 80 v. Components include :—Transformers (1) 2100-0-2100 v. tapped 500-0-500 v. (2) 450-0-450 v. 13 VCT., 6.3 VCT., 6.3 v., 5 v. (3) 2.5 VCT plus thermal starter 6.3 v. Chokes, 2/15 H 375 ma., 15 H 450 ma., 20 H., 162 ma., 2/15 H 110 ma., H.V. condensers, etc. Valves, 2/6A3's, 6SJ7, 4/866A/866's, 5Z3, VR150/30, 1 x starter tube. In metal case, finished in olive-drab crackle, with output and input sockets and switches. Dim. —2ft. 6in. x 1ft. 6in. x 1ft. with shock-absorbing feet. Wgt. 420 lbs.

CLYDESDALE'S PRICE ONLY £16 CARRIAGE PAID.

A few only.
V.L.R. CANADIAN-MARCONI RACK-MTG. RECEIVER UNIT.
Complete with power unit for 110 v. A.C. and loudspeaker, in small rack. Receiver for 1.5-28 mc/s.

CLYDESDALE'S PRICE ONLY £30 CARRIAGE PAID.

Brand New in maker's original carton.
TRANSMITTER TUNING UNITS.
Each having Vernier tuning dial; variable capacitors. Tank coil unit on ceramic former; ceramic switch; R.F. chokes, etc. In metal cabinet 17½ x 7½ x 8ins. Finish black.
TU5B. 1500-3000 kcs.
CLYDESDALE'S PRICE ONLY 22/6 each. CARRIAGE PAID.
TU6B. 300-4500 kcs. TU7B. 4500-6200 kcs.
TU8B. 6200-7700 kcs.
CLYDESDALE'S PRICE ONLY 17/6 each. CARRIAGE PAID.
TU26B. 200-500 kcs.
CLYDESDALE'S PRICE ONLY 10/- each. CARRIAGE PAID.

INFRA-RED IMAGE CONVERTER CELL.
Sniperscope. Snooperscope. The famous wartime "Cats-eye" tube used in "Tabby" for night sniping and observation.
Provides a Silver Caesium Oxide Screen for the conversion of Infra-Red Rays to visible rays, using an infra-red light source. Data provided. Dimensions overall :—dia. 2in. x 1½in. Screen dia. 1⅜in.

CLYDESDALE'S PRICE ONLY 12/6 each. POST PAID.

Brand New, in maker's original packing. Ex U.S. Army.

WIRELESS SET No. 48 MK.I. Transmitter Receiver.

American version of the No. 18 Set, modified to U.S. Army requirements. Frequency coverage 6 to 9 mcs.—33.3 to 50 metres. Complete equipment for "Phone" and C.W. comprising :—

TRANSMITTER, with 1,000 kc. Xtal, 4 valves, 1A5 master osc., 2/1299's P.A., 1LD5 mod., Xtal osc., and diode r.f. rect., etc., etc.

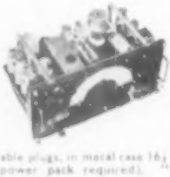
RECEIVER, superhet circuit, employing 6 valves, 1LN5 H.F. Amp., 1LA6 1st det. F.C., 1LN5 I.F. Amp. 1LD5 2nd det. and B.F.O., 1LD5 1st L.F. and A.V.C., 1A5 output, L.F. frequency 455 kc., etc., etc.

HAND DRIVEN GENERATOR, supplying H.T. and L.T. (plus 12 v. bias, when switched for WS-18) with operator's seat, etc.

AERIAL, 10ft. Rod type (11 sections) range 5 miles R.T. 10 miles C.W. greater ranges can be obtained with a normal aerial. Plus cables and **INSTRUCTION BOOK.**

This equipment can also be used with dry batteries (not supplied) as a **PORTABLE WALKIE-TALKIE.**
Power requirements H.T. 162 v. 60 ma. L.T. 3.1 v. 0-3 a. Dimensions :—Set and Battery container :—11½ x 10½ x 17½ ins.

CLYDESDALE'S PRICE ONLY £14.10.0 CARRIAGE PAID.



EX R.A.F. R1155 RECEIVER.
A 10 valve communication and D.F. receiver for 18-3 mcs., 1,500-600 kcs., 500-75 kcs. in 5 wave-bands, complete with valves, etc., circuit and available plugs, in metal case 18½ x 9 x 9ins. (external power pack required). "Airtested" before despatch.

CLYDESDALE'S PRICE ONLY 12 gns. each. F.O.B. GT BRITAIN

W.S. 18 RECEIVER UNIT.
4 valve Battery Superhet chassis covering 6-9 mcs (50-33 metres) for phone operation. Contains 4-2 volt valves, slow motion drive, I.F. coils, etc., size 9½ x 6 x 7ins. Power requirements approx. H.T. 100 v. L.T. 2 v.

CLYDESDALE'S PRICE ONLY 17/6 CARRIAGE PAID.

16 FOOT TELESCOPIC AERIAL WITH BASE.
Comprising 4 length tapering from ⅞in. to ⅜in. each section sleeved into the other with insulated base.

CLYDESDALE'S PRICE ONLY 10/6 CARRIAGE PAID.

H.ISI. JUMPER LEAD ASS.
(For WS-19) 60ft. of 5-core tinsel flex, fitted each end with a 5-way rubber plug—ZA.2994. Price 7/6 each, post paid.

AN ARC-5—SCR-274-N EX U.S.A.A.F. "COMMAND" RECEIVERS.
R-23/ARC-5 (BC-453), 550-190 kcs. or
R-26/ARC-5 or BC-454, 3.0-6.0 mcs. or
R-26/ARC-5 (BC-455), 6.0-9.0 mcs.
Brand New in maker's original carton or Unused, good condition.

CLYDESDALE'S PRICE ONLY 50/- each. POST PAID.

Or used, with case dented at 37/6 each, post paid.
Set of Circuits for SCR-274-N at 4/6, or BC-453 or BC-454 or BC-455 Circuits 1/3 each, post paid.

MEDIUM WAVE CONVERSION COIL ASSEMBLIES.
Cat. H67 for BC-453 or H68 for BC-454 or H69 for BC-455.

CLYDESDALE'S PRICE ONLY 10/- each. POST PAID.

Brand New, Ex U.S. Navy, in maker's original carton.
CONTROL BOX CCT-23155, EQUAL TO U.S. ARMY, BC-496-A.
For Two Command Receivers, with dual tuning and volume controls, switches, Inlet and Outlet points. Black crackle finish box. Dim. —6½ x 4 x 12½ins.

CLYDESDALE'S PRICE ONLY 10/6 each. POST PAID.

A few only.
RADIO SET SCR-504-A.
Comprising :—**SC-792-A** communications receiver, covering 100 kcs., 65 mcs., 3,000-4.7 metres, in 8 bands with complete coverage, an 8 valve superhet for 'phone operation, which can also be used for direction finding, housed in beautiful pigskin suitcase, size 21½ x 13½ x 6½ins., operates either open or closed. Valve line-up :—1LN5 1st I.F., 1LN5 2nd I.F., 1LN4 det., 1LN5 B.F.O., 1LN5 output (triode connected). A deafaid type of earphone is supplied with the receiver and can be fitted to either ear. Plus case **CS-96-A** containing **PE-128-A** charger, which is used from 6 or 12 volt battery and will charge a 6 volt and 2-36 volt accumulators, built in metal case with 2½in. square volt and ampmeters, with spare valves, hypodermic syringe and needles, spare vibrator, and spare ear-piece. Less batteries.

CLYDESDALE'S PRICE ONLY £35 CARRIAGE PAID.

Order direct from :—

CLYDESDALE SUPPLY CO. LTD. 2 BRIDGE STREET GLASGOW C.5

(Phone: Bank 3706) Visit our Branches in Scotland, England and Northern Ireland.

PREMIER RADIO COMPANY

MORRIS & CO. (RADIO) LTD.

Announcing

PREMIER TELEVISOR KITS

FOR LONDON AND BIRMINGHAM

USING 9" OR 12" MAGNETIC C.R. TUBES

£19·19·0 *including all parts, valves and loud-speaker, but excluding C.R. TUBE*

CIRCUIT DETAILS

The Vision Receiver consists of 4 R.F. Stages which are followed by a diode detector which is directly coupled to the Vidio Valve, which modulates the cathode of the C.R. Tube. A noise limiter is incorporated in both sound and vision receivers.

The Sound Receiver comprises 3 R.F. Stages, followed by a double diode triode which acts as detector and L.F. amplifier. The output valve is of the Beam type and drives a P.M. Loudspeaker with closed field magnet.

The Time Base employs blocking oscillators on both Line and Frame. E.H.T. is taken from the line output transformer through a voltage doubler employing two valves.

The Power Supply is from a double wound mains transformer completely isolating the receiver from the mains.

FEATURES

- ★ Uses 9 in. or 12 in. Tubes.
- ★ Noise Limiter on Vision and Sound.
- ★ Non-Lethal E.H.T.
- ★ P.M. Focusing
- ★ Uses 21 valves
- ★ Each Kit available separately
- ★ Recommended for use in fringe areas.

CONSTRUCTION BOOK 3/-

Ready March 25th, 1950

★ Delivery of Kits will commence immediately after

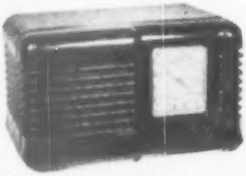
No other details will be available until March 25th, 1950

167 LOWER CLAPTON ROAD, LONDON, E.5

Telephone: AMHerst 4723

PREMIER RADIO COMPANY

MORRIS & CO. (RADIO) LTD.



PREMIER MIDGET RADIO KIT. Due to greatly increased production we are now able to offer this Kit at a greatly reduced price. Including an attractive Brown or Ivory Bakelite case, 12in. long × 5in. wide × 6in. high. The valve line-up is 6K7, 6J7, 6V6 and a Selenium Rectifier in the A.C. model, and 6K7, 6J7, 25A6 and a Selenium Rectifier in the A.C./D.C. model. Both are for use on 200 to 250 volt mains. The dial is illuminated, and the receiver presents a very attractive appearance. Coverage is for the medium and long wavebands.

Complete kit of parts with cabinet and diagrams, **£4 19 6**, inc. Purchase Tax.
State if A.C. or A.C./D.C. is required.

PREMIER MIDGET SUPERHET KIT. This powerful Midget Superhet Receiver is designed to cover the short-wave bands between 16 and 50 metres and the medium wavebands between 200 and 557 metres. Two models are produced, one for 200-250 volt A.C. mains, and the other for 200-250 volts A.C. or D.C. mains. Both are supplied with the same plastic cabinet as the T.R.F. Receiver. The A.C. valve line-up is 6K8, 6K7, 6Q7, 6V6 and a Selenium Rectifier. The A.C./D.C. line-up is the same, with the exception of the output valve, which is a 25A6. The dial is illuminated, making a very attractive receiver.

Complete kit of parts with cabinet and diagrams, **£6 19 6**, inc. Purchase Tax.
State if A.C. or A.C./D.C. is required.

PLASTIC CABINETS, as illustrated above. In Brown, or Ivory, **17/6**.

COLLARO AUTOMATIC RECORD CHANGERS. Type [illegible] Rim-drive. Plays nine 10in. or 12in. records. A.C. 100/250 v., with High Fidelity Magnetic or Crystal Pick-up, **£10 15/-**. With Sapphire Stylus, **£11 8 4**.

COLLARO GRAMOPHONE UNITS. High-grade Rim-drive Motors, complete with Pick-up and Automatic Stop-Start. A.C. 100/250. With Magnetic Pick-up, **£5 3 2**. With Crystal Pick-up, **£5/17/7**.

COLLARO GRAMOPHONE UNITS AT NEARLY HALF PRICE. Motor, Tone arm and Pick-up in one unit. Auto Stop-Start, variable speed, 12in. turntable. Induction Motor for 100/250 v., 50 cycles, with Magnetic Pick-up, **£6 6/-**. With Crystal Pick-up, **£7 4 8**.

CONRAD GRAMOPHONE MOTORS. A reliable Rim-drive Motor for A.C. 200-250 v. operation **£2 17 6**.

GOVERNMENT SURPLUS MAINS TRANSFORMERS. All are for use on 230 volt 50 cycle Mains.

Type		Price
[illegible]	[illegible]	25/-
[illegible]	[illegible]	15/-
[illegible]	[illegible]	15/-
[illegible]	[illegible]	17/6

WILLIAMSON AMPLIFIER KIT. We can supply the Kit of Parts for the latest version of this famous amplifier complete in every detail for **£10 10/-**.

WILLIAMSON AMPLIFIER OUTPUT TRANSFORMERS to specification, **63/-**.
Mains Transformers, **45/-**.

H.T. ELIMINATOR AND TRICKLE CHARGER KIT. All parts to construct an eliminator to give an output of 120 volts at 20 mA. and 2 volts to charge an accumulator. Uses metal rectifier. **35/-**.

TELEVISION AERIALS. The K.A. Loft Aerial for those close to the transmitter. London or Birmingham frequency, **20/-**.

WALL FIXING DIPOLE, **32/6**.

WALL FIXING DIPOLE, with reflector, **60/-**.

See our new catalogue for complete range.

V.C.R.97. C.R. Tubes. New and tested to give full size picture, **35/-** each.

The following C.R. Tubes for callers only:—

Type	Diameter	Persistence	Price
[illegible]	[illegible]	Long	5/-
[illegible]	[illegible]	Short	15/-
[illegible]	[illegible]	Short	15/-
[illegible]	[illegible]	Long	20/-
[illegible]	[illegible]	Short	15/-

All have 4 v. Heaters. Screen colour is green.

TRANSMITTING AND SPECIAL PURPOSE VALVES.

[illegible]	10/-	[illegible]	5/-
801	60/-	[illegible]	25/-
832	10/-	[illegible]	15/-
[illegible]	6/6	[illegible]	15/-
[illegible]	40/-	[illegible]	5/-
[illegible]	17/6	[illegible]	10/-
[illegible]	60/-	[illegible]	5/-
[illegible]	60/-	[illegible]	5/-
[illegible]	60/-	[illegible]	6/6
[illegible]	7/6	[illegible]	3/6
[illegible]	5/-	[illegible]	5/-
[illegible]	20/-	[illegible] (Klystron)	5/-
[illegible]	5/-	[illegible]	7/6
[illegible]	6/6	[illegible]	3/6
[illegible]	6/6	[illegible]	6/6
[illegible]	6/6	[illegible]	6/6
[illegible]	6/6	[illegible]	6/6
[illegible] Magnetron		[illegible]	6/6
[illegible]	40/-	[illegible]	40/-

ELECTRON MULTIPLIER PHOTO CELL TUBES. Type 931A. Brand new. Guaranteed, **30/-**. Base, **2/6**.

T.V. WHITE RUBBER MASKS. We can now supply a specially designed White Rubber Mask for [illegible] C.R. Tubes at **7/6** each. [illegible] White Masks, **9/6**. 12in. White Masks, **15/-**.

SUPER QUALITY TELEVISION MAGNIFYING LENS. [illegible] Tubes. Increases picture size considerably. **25/-** each.

FRAME AND LINE COIL ASSEMBLY. Suitable for all standard Magnetic Tubes, **12/6** each.

PERMANENT MAGNET FOCUS POTS. Available for all Tubes, **15/-**. Please state Tube used.

> **THE NEW**
> **PREMIER 1950 CATALOGUE**
>
> contains all the newest TV Kits, Components, Aerials, Tubes, etc., in addition to thousands of Radio Bargains.
>
> **Now ready — 3d.**

SUPER MOVING COIL MIKE AND STAND. We have purchased the entire stock of a famous Manufacturer of PA Equipment at a very low price, and are offering a £[illegible] Super Moving Coil Mike, with a chromium plated folding stand to match. The list price of the stand was £[illegible].
WE OFFER THE PAIR AT 79/6. LESS THAN HALF THE USUAL PRICE.

> We can supply all parts from Stock for the VIEW-MASTER Televisor. For London or Birmingham. Instruction Booklet, **5/-**, post free.

LOUDSPEAKERS by famous makers.

[illegible]	9/-	[illegible]	12/6
[illegible]	10/-	10in.	23/6
[illegible]	13/6	12in.	39/6

MULLARD MW22-3 9in. MAGNETIC TUBES. We can offer a limited quantity of these new and unused Tubes at **£8 15/-**. TO CALLERS ONLY.

MOVING COIL EARPIECES. Comprise a 1¼in. Moving Coil Loudspeaker fitted with noise excluding rubber case. Make excellent Mikes, Phones or Speakers. **2/-** each.

SPECIAL HEADPHONE OFFER. High-grade Double Headphones, using balanced armature units, D.C. Resistance [illegible] **3/6** per pair. Matching transformer if required, **2/6** each.

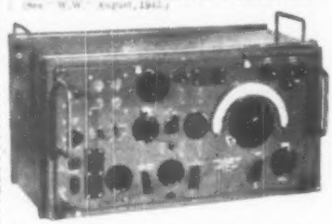
SPECIAL OFFER OF ELECTROLYTIC CONDENSERS

[illegible] working	4/11
[illegible] working	4/3
[illegible] working, all cans	4/11
[illegible] working	2/6
[illegible] working, all cans	2/6
[illegible] working, cardboard	3/6
[illegible] working, cardboard	2/3
[illegible] working, cardboard	2/6
[illegible] working, all cans	4/11

All Capacities and Voltages available.

MOVING COIL METERS. All [illegible] diameter. 1 mA., **7/6**; [illegible] mA., **5/-**; 50 mA., **8/6**; 150 mA., **6/-**; [illegible] amp., **7/6**; [illegible] amp., **7/6**; [illegible], **5/9**; [illegible], **5/9**; [illegible] microamps, **7/6**. All [illegible] diameter: 1 mA., **15/11**; [illegible] mA., **10/6**; [illegible] mA., **8/6**; [illegible] microamps, **19/6**; Thermocouple meters, [illegible], **5/-**; [illegible] amp., **5/-**; [illegible] amp., **5/-**; [illegible] amp., **8/6**; Electrostatic, [illegible], **25/-**.

A LARGE NEW PURCHASE ENABLES US TO OFFER AT A LOWER PRICE THAN EVER R107. ONE OF THE ARMY'S FINEST COMMUNICATIONS RECEIVERS. (See "W.W." August, 1945.)



9 valves, R.F. amp. osc. Frequency Changer, 2 I.F.s (465 kc.), 2nd Detector, A.V.C. AF amp. B.F.O. A.C. mains, 100-250 v. or 12 v. accum. Frequency range 17.5 to 7 Mc/s, 7.25 Mc/s to 2.9 Mc/s, 3.0 to 1.2 Mc/s. Monitor L.S. built in. Complete. Write for full details. Price **£12 12/-**, plus 21/- carriage and packing.

BATTERY CHARGERS. Input 200/250 v. A.C. Output 16 volts at 10 amps. Continuously variable metered output. Usual price £24. Our price, **£10 10/-** each, plus 10/- carriage.

BATTERY CHARGER KITS. All incorporate Metal Rectifiers. Transformers are suitable for 200-250 v. A.C. 50 cycles.

Cat. No.		Price
2002.	Charges 6-volt Accumulator at 1 amp. Resistance supplied to charge 2 v. Accumulator	£1 2 6
2003.	Charges 12-volt Accumulator 1 amp.	£1 7 6
2004.	Output 12 v. 4 a. Variable Resistance and Meter	£3/15/-
2005.	Output 15 v. 6 a. Variable Resistance and Meter	£5/-/-
2007.	Output 30 v. 5 a. Variable Resistance and Meter	£6/-/-
2008.	Output 24 v. 3 a. Variable Resistance and Meter	£4 5/-

ALUMINIUM CHASSIS. 18 S.W.G. Substantially made of bright aluminium, with four sides.

Size	Price
[illegible]	3/3
[illegible]	4/-
[illegible]	5/6
[illegible]	6/8
[illegible]	6/11
[illegible]	7/3
[illegible]	7/11
[illegible]	10/-
[illegible]	6/3
[illegible]	6/10
[illegible]	7/11
[illegible]	8/6
[illegible]	10/-

MAINS NOISE ELIMINATOR KIT. Two specially designed chokes with three smoothing condensers with circuit diagram. Cuts out all mains noise. Can be assembled inside existing receiver. **6/-** complete.

CO-AXIAL CABLE. Super quality cable, consisting of a centre copper core, a polythene insulator, a flexible screen, a weather-proof P.V.C. outer cover. Just the thing for Television lead-in, super mike cable, etc., 80 ohms impedance, Cat. No. [illegible], **3d.** per foot.

GRAMOPHONE AMPLIFIER KIT. Consists of Complete Kit of Parts for a 2½ watt, Mains-operated Single Amplifier for use with any type of pick-up. Volume and tone controls are incorporated. Output impedance is 3 ohms.
Cat. No. AMP147. Price complete, **65/-**. For 200-250 v. mains with valves and diagrams.

SECTIONAL WHIP AERIAL. Seven sections which plug into each other making an aerial 14ft. long. Thinnest section [illegible] diam., thickest section [illegible] diam. Weather-proof enamel. **3/6** each complete.
INSULATED BASE for above, **2/6** each.

METER KIT.
A FERRANTI 500 MICROAMP M.C. METER, with separate High Stability, High Accuracy, Resistors to measure 15, 60, 150 and 600 volts D.C. Scale length [illegible], diameter [illegible]. **10/-** the complete kit.

5 KV. ELECTROSTATIC VOLTMETER. Scale length [illegible], flush mounting, [illegible] diameter. **£2 10/-**.

207, EDGWARE ROAD, W.2 Phone: AMBassador 4033 **BRANCHES AND AT—**

All **POST ORDERS** to 167, LOWER CLAPTON ROAD, LONDON, E.5. 'Phone: AMHerst 4723

Terms of Business: Cash with order or C.O.D. over £1. Send 2d. stamp for list.

EDGWARE ROAD IS OPEN UNTIL 6 p.m. ON SATURDAYS

PREMIER RADIO COMPANY

MORRIS & CO. (RADIO) LTD.

THE BIRMINGHAM VERSION OF THE

"PREMIER" TELEVISOR KIT

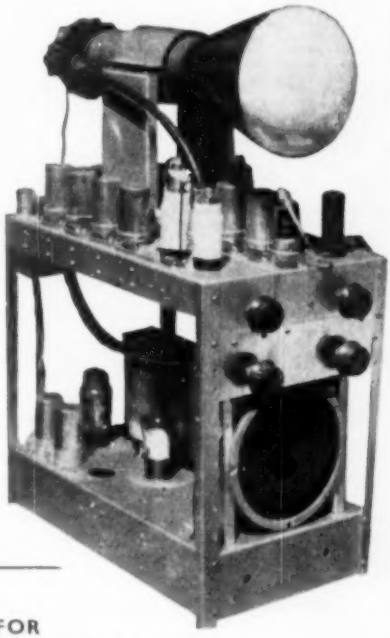
is now ready. The price is the same as the London Model

£17 - 17 - 0

As is usual in all Premier Kits every single item down to the last Bolt and Nut is supplied. All chassis are punched and layout diagrams and theoretical circuits are included.

Five Easy to Assemble Kits are supplied :—

VISION RECEIVER with valves, carriage 2/6	£3 13 6
SOUND RECEIVER with valves, carriage 2/6	£2 14 6
TIME BASE with valves, carriage 2/6	£2 7 6
POWER SUPPLY UNIT with valves, carriage 5/-	£6 3 0
TUBE ASSEMBLY, carriage and packing 2/6	£2 18 6



This unit includes the VCR97 Tube, Tube Fittings and Socket and a 6in. P.M. Moving Coil Speaker with closed field for Television. The Instruction Book costs **2/6,** but is credited if a Kit for the complete Televisor is purchased.

Any of these Kits may be purchased separately ; in fact, any single part can be supplied. A complete priced list of all parts will be found in the Instruction Book.

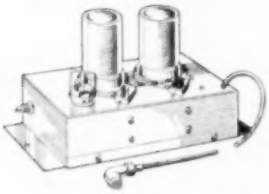
20 Valves are used, the coils are all wound and every part is tested. All you need to build a complete Television Receiver is a screwdriver, a pair of pliers, a soldering iron and the ability to read a theoretical diagram.

A well-made walnut finish

PEDESTAL CABINET

is available at **£5 10 0** *plus 7/6 carriage and packing.*

Working Models can be seen during transmitting hours at our Fleet Street and Edgware Road Branches.



PRE-AMPLIFIER FOR FRINGE RECEPTION AREAS

We can supply the complete kit of parts to make this wide band width Pre-Amplifier, using 2 EF54 Pentodes. Powered by the TV Kit, it is completely screened. With all parts, valves, chassis, diagrams, etc., **27/6.** All parts available separately.

PLEASE STATE IF THE LONDON OR BIRMINGHAM MODEL IS REQUIRED.

AT **152-153, FLEET STREET, E.C.4** Phone : CENtral 2833

All **POST ORDERS** to 167, LOWER CLAPTON ROAD, LONDON, E.5. 'Phone : AMHerst 4723

Terms of Business : Cash with order or C.O.D. over £1. Send 2d. stamp for list.

207, EDGWARE ROAD IS OPEN UNTIL 4 p.m. ON SATURDAYS

HALF LIST PRICE

Radiogram unit by a very famous maker, comprising centre drive induction motor type AC47 with speed regulator, auto-stop and magnetic pick-up all mounted on full size unitplate. Brand new in manufacturer's cartons. Limited quantity. **£4 16 6**, plus 3/6 carriage and insurance.

SELECTED SURPLUS (Ex-Govt.)

10 K.V.A. ALTERNATOR SETS. Ideal for country house or if you are setting up a workshop or laboratory in a remote place, then these are an ideal unit, because in addition to the main output of 10 K.V.A. 230 v. 50 cycles 3-phase there is also 1.5 K.V.A. 230 v. 400 cycles. These alternator sets are complete with exciter, voltage regulators, switch board, frequency meters, amp. meters, and iron-clad switch fuses for output. They are mounted on stout angle-iron stand and are complete with "Vee" belt pulley, the alternator is designed to run at 1,500 r.p.m., but being belt-driven they can, of course, be driven by an engine of almost any speed, as the difference can be adjusted by the size of the pulley on the engine. Unused but storage soiled. Price is **£85** each ex works.

TYPE 6 INDICATOR. As specified for the "Wireless World" oscilloscope (reprint of data **9d.**). Also for the "Inexpensive Television" (booklet **1/6**), and the Mark I Televisor (Constructors envelope **2/6**). These indicators are brand new, packed and sealed in manufacturer's original crates, they contain VCR.97 Cathode Ray Tube, 4 EF50 valves, 3 other valves, and hundreds of useful components, including wire-wound pots. Price is only **£4 19/-**, plus carriage and packing 7/6.

10 VALVE 1½ METRE SUPERHET. Ideal for conversion into a Midlands or London region Televisor. These contain 5 valves type SP61, and 1 each RL7, RL16, and EA50. 6 I.F. Transformers of 12 mc/s, 4 mc/s band width, and hundreds of other useful components. Complete with 3 11 mm. formers, price **59/6**, plus carriage and packing 5/-. These receivers are unused, being in original wrappings.

RADAR RECEIVER TYPE 3084A. These require only the smallest of modification to make them into a sound and vision televisor. Main contents are valves: 7 EF50, 2 VR136, 1 VR137, 1 HVR2, 1 R1, 1 V507, 1 EA50, wire-wound variable resistors, small 80 v. A.C. motor, and dozens of useful components, resistors, condensers, etc. Brand new, in original manufacturer's packing and transit case, price **59/6**, carriage 5/-.

RECEIVER R.3585. An ideal unit for conversion to T.V. in the London Service Area, as it contains a "PYE" 45 mc/s I.F. Strip, and valves as follows: 7 EF50, 4 SP61, 8 EF36, 1 EB34, 1 EF39, brand new—only **90/-**, carriage, etc., 7/6.

RECEPTION SET BP411. Made by Philco. 4 valve battery superhet. Valve line up, frequency changer, I.F. amplifier, double diode triode and output pentode. Complete with all valves and 9in. P.M. speaker. Provision for phone output incorporated. Cabinet size 10½in. x 7½in. x 7½in. Controls are volume, ON/OFF switch, and tuning. Frequency coverage 1.4 to 4 mc/s, 75–222 metres (Trawler, 80 and 160 metres Amateur bands). Only **£3 19/6**, plus 5/- carriage and packing.

TRANSMITTING AND SPECIAL VALVES

ALL BRAND NEW IN ORIGINAL CARTONS, MOSTLY AMERICAN MAKE.

813	47/6	866A	10/6	807	7/6
6L6	10/6	6A3	12/6	2A3	9/-
TZ40	27/6	CV57	30/-	807U	18/6
35T	25/-	VR150	12/6	1625	5/-
1Z3	13/6	6N7	6/6	833	16/6

GU21 (CV5) VS68 (STV280/40) PT15 (VT104)
VT25 (DET25) VU508 (CV1508) RK34

Many other types available, including Magnetrons, Klystrons, Thyratrons, etc., etc. Send us your enquiries.

PARTS FOR TELEVISORS

£20 FOR A MAGNETIC TELEVISOR (and H.P. terms if you wish). This Televisor is suitable for use with 9, 10, or 12in. magnetic tube (not included in the £20). No ex-Government units are used, you start off with all basic components, brand new and guaranteed, except for the valves which are Government Surplus though again guaranteed. This Televisor was demonstrated at Radiolympia, and we will demonstrate to you if you can call during transmitting time. All parts available separately for those already having some of them. Detailed point-to-point wiring and instructions for novice or expert, **5/-**. Explanatory leaflet free. When ordering booklet please state whether for Birmingham or London.

TELEVISION You can Build

R.F. E.H.T. Non-Lethal

R.F. E.H.T. We were so pleased with the quality of this unit that we have taken up the entire output of the manufacturer, the voltage can be adjusted to make it suitable for working 9in., 12in. or 15in. tubes, the unique design and vacuum impregnation combine to give a trouble-free unit which will give years of satisfactory service, and, of course, the big point about the R.F. E.H.T. is that it is not lethal, the size is only 4½ x 3½ x 4in., price complete ready to operate, **65/-**.

£15 5/- FOR A COMPLETE TELEVISOR. This is our famous Mark II which is doing good service all over the country. Two Ex-R.A.F. Units are used, and these save you a good deal of work. These and all the other parts, including the loudspeaker needed to make the working televisor, are included in the **£15 5/-**. Technical knowledge is necessary because you have to work from theory diagrams. 24 pages of data are included free if you buy the Kit, or alternatively will be supplied at **7/6** per copy.

"50 PITFALLS FOR TELEVISION CONSTRUCTORS." If you are having difficulty in getting a perfect picture, then this publication may solve your problem. The price is only **2/6** post free.

WHITE RUBBER MASK. Designed to fit a 6in. electrostatic tube, VCR.97, etc. This will give a professional look to your home-built Televisor. If yours is a bigger than usual picture, the size of the opening can be enlarged to suit your own needs. The price is **7/6** post free.

MAGNIFYING LENS. De Luxe type. The lens which is really designed to give optical perfection. First-class quality and workmanship throughout. Guaranteed against any discolouration of the special oil content. Price **39/6**, postage, packing and insurance 5/-.

AERIALS. Indoor type—for fitting in loft. Very simple in installation. Full instructions and fixing clips, etc., supplied with every one. Order "SNAPPY AERIAL KIT," price **15/-**.

VCR.97 CATHODE RAY TUBES. Brand new in original cartons. Price **35/-**, carriage and insurance paid. Buy a spare now while they are still available at this silly price.

PRE-AMPLIFIER FOR TELEVISION. 2-valve unit made up and wired ready to work, complete with valves and input and output plugs, **39/6**.

Conversion details using RF27 (ex-R.A.F. Unit). Unit with details **22/6**. Nothing else needed, suitable for sound or vision. Details separately, **2/3** post free.

CO-AXIAL CABLE. 80 ohm thin, **10d.** per yard, 80 ohm Government surplus thick, **8d.** per yard. Twin balanced feeder, **6d.** per yard.

E.H.T. CONDENSERS. .1 mfd. 2.5 K.V., **2/6**. .1 mfd. 5 K.V., **4/9**. .1 mfd. 7 K.V., **12/6**. .02 mfd. 8 K.V., **3/9**.

DECOUPLING CONDENSERS. Very small bakelite moulded mica insulators, .001 mfd. or .0005 mfd., **6/-** per dozen.

FRAME AND LINE COIL ASSEMBLY. Perfectly made by a very famous maker, for standard type magnetic tubes, 9in., 10in., 12in. or 15in., we have a limited number only, the price is **16/6**, and cannot be repeated once these are cleared, so please act quickly.

PERMANENT MAGNETIC FOCUSING UNITS. No current drain—for all makes of tubes—patented method of adjusting the gap, giving really clean pictures and even focus of whole of the tube free. Price **16/6** each.

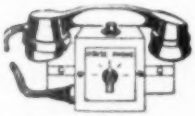
P.M. FOCUSING for clear pictures

ELECTRONIC PRECISION EQUIPMENT (2) ELECTRON HOUSE, Windmill Hill, RUISLIP MANOR, MIDDX.

FREQUENCY METERS BC221

American Manufacture. Accuracy .005%. Frequency range 125-20 mc/s. Crystal controlled and temperature compensated. Makes an excellent V.F.O. without impairing its use as a frequency meter. Brand new and unused, complete with instruction book, **£25**, carriage paid. We have also a limited quantity of used BC221 Frequency Meters in good condition. Carriage paid, **£15**.

HOUSE TELEPHONES



Desk or Wall Mounting

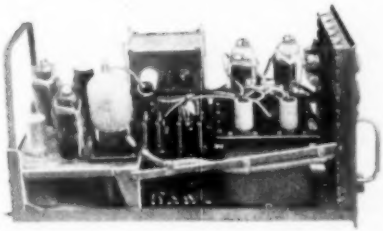
Suitable for intercommunication between offices, workshops, stores, garages, big houses, kitchens, etc. Each station consists of normal size Bakelite handsets and desk or wall mounting cabinet with built-in selector switch, buzzer and push. All stations can communicate with one another independently. Each installation is absolutely complete and internally wired. 3-station installation complete with 50 yards 5-core cable **£6 10 -**. 4-station installation, complete with 50 yards 6-core cable, **£8 10 -**. 2-station installation, complete with 25 yards 4-core cable, **£3 17 6**.

ELECTROLYTIC CONDENSERS

8 mfd. 350 v.	1 6
16 mfd. 350 v.	1 11
25 x 25 mfd. 200 v.	3 11
8 mfd. 150 v.	1 3
25 mfd. 25 v.	1 -
25 mfd. 50 v.	1 6
50 mfd. 12 v.	10d.
50 mfd. 50 v.	1 9
10 mfd. 25 v.	10d.
2 mfd. 450 v.	1 -
4 mfd. 450 v.	1 3
8 mfd. 450 v.	1 11
16 mfd. 450 v.	2 8
8 x 8 mfd. 450 v.	3 4
8 x 16 mfd. 450 v.	3 4
16 x 16 mfd. 450 v.	3 9
16 x 8 x 24 mfd.	4 2
8 mfd. 500 v. BR.850	2 6
16 mfd. 500 v. BR.1650	3 6

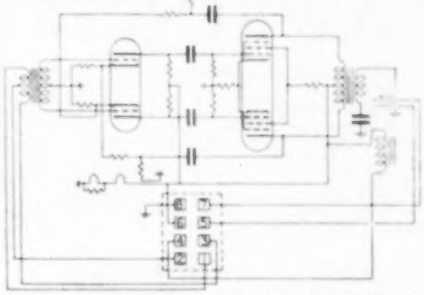
MISCELLANEOUS ITEMS

8 kv. sleeving, 3/- doz. yds. B7G ceramic valve holder, 1/3. Ditto, EF50, **9d.** Pax EF50, **6d.** Int. Oct. Valve holder Amphenol, **6d.** Pax, **3d.** Miniature look pots, **1/6.**



Our latest purchase of ex-Government material includes a batch of RADAR Units, type 64. Each unit contains :—
2 VR91's, the popular EF50.
1 VT60A, the always useful 807.
1 CV73, the television output valve now in great demand, KT44, Pen 46.
2 CV54's, high voltage rectifier, V966, will rectify 2.5 KV at 60 ma.
1 CV85, an enclosed triggered spark gap valve, type V2023. A steel case, size 21in. x 8in. x 11in. high, containing a chassis and framework on which are mounted all the valve bases for the above, 8 PYE sockets, 1 high ohmage relays, 6 paper condensers, 1 metal rectifier, 3 potentiometers, 1 ON OFF toggle switch, 1 .05 mfd. x 3,500 v. condenser, 1 .5 x .5 x 2,200 v. condenser, 30 assorted resistors, ½, 1, 2 and 3 watts, paxolin resistor panels, plus various other sundries such as useful clips and mounting brackets, etc.
Whichever way you look at this, the value of the goods is terrific. THE PRICE OF THE UNIT (including valves) is **18/9**, plus 5/- carriage, as these units weigh nearly 40 lbs.

PRE-AMPLIFIER MODEL K



The above is the circuit diagram of pre-amplifier model K. You will notice that the circuit includes two double valves, push-pull input and push-pull output transformers, a relay, a choke, and numerous small resistors and condensers. The whole thing is complete with valves wired up and enclosed in a metal case size approximately 5½in. x 4in. x 4in. You will readily appreciate that this little unit will fit in almost any cabinet, including table models. These units are very well made by a famous American company, originally intended for Forces use, to increase the output of low gain microphones and pick-ups. We have a fair quantity available, all new and unused, the price is **17/6** each and as this is the equivalent of a 4-valve push-pull amplifier, it is of course enormous value. We anticipate a big demand, so please order by return.

SPANNER KIT

For servicing all types of British and American gear. You have needed these spanners in the past and you will continually need them in future. Total of 50 precision tools :—
5 Whitworth ring spanners ¼–¾.
5 American ring spanners, ¼–¾.
6 Double-ended Whitworth ¼–¾.
6 Double-ended American ¼–¾.
3 Whitworth obstruction wrenches ¼ to ⅞.
3 American obstruction wrenches ¼–⅞.
6 B.A. Ignition spanners 1/6 B.A.
6 American Ignition spanners.
4 Small B.A. Fitters' spanners.
3 Small American Fitters' spanners.
3 Small Whitworth Fitters' spanners.
This complete kit, **£5 17/6.**

B.A. SOCKET SPANNERS

Covering sizes 0–6 B.A. and with double ended wrench as illustrated. A really good set which will help you with those nuts in awkward corners, price **5/6** complete.

POLISHED B.A. SPANNERS

Covering sizes 1 to 6 B.A., these are so made to have a straight and a right angle end for each B.A. size. **6/-** set.

QUADRANT-TYPE DIVIDERS

For marking out chassis these are the ideal tool normal price 7/6, our price while they last, **3/9**.

BREAK-DOWN PARCEL

In a store which we have to clear are a large number of ex-W.D. units which we intended to break down for spare parts. We shall not have time to do this, so we are offering these units to you at the ridiculous price of **4/6 each**, plus 1/6 postage. At present-day prices the spares in this unit would cost at least £5. Here is a list :—

3	2-metre coils.
3	Tuning Condensers, slip stator type.
4	2-watt Carbon Resistors, all useful values.
1	Tapped 20-watt Resistor, vitreous 20 and 17 ohm sections.
	2-watt Carbon Resistors, useful values.
6	.05 1,000 volt Paper Condensers.
3	.1 1,000 volt Paper Condensers.
1	Heavy metal chassis, size 12in. x 7in. x 2in.
1	Louvred Casings, size 12in. x 7in. x 4in., Finished grey cellulose.
2	H.F. Chokes.
4	.1 mfd. 450 Paper Condensers.
2	.15 volt Paper Condensers.
5	.001 Mica Condensers, bakelite enclosed.
1	.01 3,000 volt Paper Condenser.
24	Rubber Grommets, assorted sizes.
6	1 watt Resistors, all useful values.
6	½ watt Resistors, all useful values.
40	¼ watt Resistors, all useful values.
40	Silver Mica Condensers, assorted values, including 10, 15, 20, 40, 50, 150, 300 and 500 M.M.F. types.
4	English Octal Valve Holders.
2	5-pin Valve Holders.
1	9-pin Valve Holder.
3	Diode Dr Valve Holders.
8	Condenser Clips, assorted sizes.
2	Insulated Output Sockets.

ALSO: Assorted Nuts, Bolts and P.K. self-threading Screws. Miscellaneous bits and pieces, including four Tag Boards, 14 Chassis mounting connection Tags, Grid Caps, screened and otherwise, Levers, Rollers, Connecting Rods, Rubber Retains, etc., etc.

ELECTRONIC PRECISION EQUIPMENT (2) ELECTRON HOUSE, Windmill Hill, RUISLIP MANOR, MIDDX.

LAWRENCES

TELEVISION MASTS. 36ft. Made by Bendix Corp. U.S.A. Telescopic, 5in. dia., self supporting on patent base. Constructed of laminated resin impregnated timber. This superbly engineered product is ideal for mounting beam arrays, etc. As supplied to leading industrial and public concerns. Complete **£6.**

NEW AMERICAN FEEDER CABLE. Type RG7U. 72 ohms. Type RG8U 52 ohms. Latter provides improved match to multi-element Television arrays. Supplied in any length, **9d.** yd., minimum 10 yds. Quotations for quantities.

TELEVISION MAGNIFYING LENS. A most satisfactory method for improved viewing of 5in., 6in. or 7in. tubes. Easily installed. **27/-.**

METAL STORAGE CABINETS. 12 sliding drawers. Ideal for the segregation and storage of small parts. Overall size 6in. x 10½in. x 7½in., **17/6.**

I.F. TRANSFORMERS. 12 mcs. Permeability tuned. Fully screened. Suitable for T.V. strips, etc., **4/-** ea.

SPECIAL CONVERSION COMPONENTS FOR SCR274N COMMAND RECEIVERS. Medium Wave Coils, for BC453, BC454, BC455. Speedily fitted, without additional modification. Full instructions supplied. Please state type required. Complete coil assembly, **10/6.** Specially produced AC Power Packs, plug on to receiver and operate set from 230 v. supply without tedious modifications. Complete with valve rectifier. **45/-.** Command Receiver Dynamotors, 28 v. plug-on type, exact replacement. Now, **£2/6.** Circuit diagrams for SCR274N, **2/6.**

RADAR ATR GAS GAPS TYPE 724A. Complete with silver plated tunable cavity. **15/-.** List of Radar spares, etc., on request.

NEW R.C.A. QUALITY AMPLIFIERS. Several types in stock rated at 15 and 25 watts output. For 230 v. A.C. From **£15.** Details on request.

NEW AMERICAN JENSEN 15in. AUDITORIUM ENERGISED SPEAKERS. Ortho-dynamic model A-15. Excellent response. A limited stock at **£7/10/-.**

ELECTRON MULTIPLIER PHOTO CELLS TYPE 931A. High sensitivity, **27/6,** new.

NEW CONDENSERS. Can 2 x .075 mfd. 8 kV., **8/6**; can 4 mfd. 2 kV., **4/6.**

C.R. TUBES. Type 2AP1, complete with holder and mumetal screen, **25/-**; Type 5FP7, flat screen, **25/-**; Type VCR97, in maker's crate, **37/6.**

SKY WAVE WHIP AERIALS. Nine foot element. Base insulator has long leakage path for all weather operation. Mounted on roof-top, this aerial provides first class results, and reduces interference level. To clear at **7/-.**

R.C.A. FOCUSSING COILS. For electromagnetic tubes, with neck diameter up to 1.5in., **6/6.** Also Deflector Coil Unit, **6/6.**

F.M. DOUBLE SUPERHET RECEIVERS, TYPE BC923A. Freq. range 26-40 mcs. 16 valves. Operate on 12 v. D.C., and ideal for mobile work. Built in crystal calibrator. Speaker integral. A really fine instrument, **£10.**

RECEPTION SETS R20I. Probably the most advanced and elaborate type in existence, this set tunes 1.5-22 mcs. and employs eighty-three valves in circuit. Operate on 230 v. A.C. Overall height 6ft. Complete with valves and set of spares, **£65** plus carriage.

NEW MAGNETRON MAGNETS. 9 lbs. Possess enormous powers of attraction and lift much more than their own weight. Multitudes of uses. **5/-.**

MAGNETRONS TYPE RK 725A, complete with magnet, 3 cm. 50 kW. **50/-.**

TRANSFORMERS. We have in stock a large variety of 230 v. Transformers including many unusual and useful types. Also types for other voltages. Please send for clearance price list.

NEW AMERICAN STAR IDENTIFICATION INSTRUMENTS. Complete with charts for all latitudes in Northern and Southern Hemisphere. In leather case with instructions. Only **5/-.**

Satisfaction Guaranteed or money refunded

Terms C.W.O. Prices include carriage

LAWRENCES,
61, Byrom Street,
Liverpool, 3.

Telephone: CENtral 4430

TELEVISION SPECIALS

LASKY'S RADIO — Government Surplus Bargains — Cunningham 1979 — Hibbert R.T.A. — World Renowned for Service & Reliability

RADAR RECEIVER TYPE 3004A. BRAND NEW AND UNUSED. IN MAKER'S ORIGINAL WOOD TRANSIT CASE. Specification: 14 brand new valves, 7 EF50, 1 VR150, 1 VR137, 3 HVR2, 1 R3, 1 VR87, 1 EA50.

Dozens of useful components, including an 80 volt A.C. motor used for aerial switching, fine mechanical gearing, control, etc. Wonderful opportunities for this unit will be ideal for television receiver. Also suitable for converting to a 2 metre receiver. Totally enclosed in metal case, size: 19in. x 10½ x 7in. Weight in case 40 lb.

LASKY'S PRICE **59 6** carriage 10/- extra.

CIRCUIT NOW AVAILABLE. Full circuit for the 3004A receiver. PRICE **1/6.** Also of interest:

Conversion of the receiver type 3004A to television sound and vision reception PRICE **2/6,** plus 9d. postage.

Full circuit diagram giving suggested sound and vision television receiver, time base and all associated circuits, power packs, etc., utilising available Ex. Government equipment (3004A, VCR97, etc.). PRICE **3/6,** plus 9d. postage

PRICE FOR THE COMPLETE SET OF 3 CIRCUITS, **7/-.** POST FREE.

CATHODE RAY TUBES TYPE VCR 7. BRAND NEW EX. GOVERNMENT. FULLY GUARANTEED. SUPPLIED IN SPRUNG WOOD TRANSIT CASE.

Characteristics: Heater 4 volts 1 amp., H.T., 2.5 kV. maximum. Tested before despatch.

LASKY'S PRICE **35 -** carriage free.

VCR97 SCREEN ENLARGERS. LATEST TYPE PLASTIC OIL FILLED LENSES. Will give a bigger, better, clearer, and sharper picture from your 5in. cathode ray tube.

LASKY'S PRICE 1st grade **29 6** postage 1/6 extra.

2nd grade **25 -** postage 1/6 extra.

E.H.T. TRANSFORMER FOR THE VCR97 CATHODE RAY TUBE. 200-250 volts primary. Secondary 2.5 kV. 4.0 m.a.; 4 v. 1.1 a.; 4 v. 1.5a CT.

LASKY'S PRICE **35 -** post 1/6 extra.

BRAND NEW RADAR UNITS. SUPPLIED IN WOOD TRANSIT CASE. Containing 23 brand new valves (10 EF50, 2 VR91, 3 EB34, 1 VR91, 1 VR137, 1 VR87, 1 EA50), also a considerable amount of M.C. I.F. strip (bearing part type 1005). Hundreds of components, resistors, condensers, 12 potentiometers, relays, switches and amplifiers, valve holders, etc. Totally enclosed in metal case, black finish. Overall dimensions 7½ x 10 x 5½in.

LASKY'S PRICE **130 -** carriage 5/6 extra.

BRAND NEW AND UNUSED. IN MAKER'S ORIGINAL CARTON. EX. A.M. UNIT TYPE 507 C WW. Containing 19 new valves (3 3Ds, 2 2Ds, 1 VU120, 1 6X5GT, 1 EF50, 1 EF53, 1 VR91, 2 VR116 voltage stabilisers).

Dozens of various components, including high voltage condensers, chokes, potentiometers, resistances, condensers in oil, 200 v.a.c., etc. Totally enclosed in metal case, size: 19in. x 11½in. x 9in. Weight 40 lb.

LASKY'S PRICE **49 6** carriage 5/- extra.

CO-AXIAL CABLE. SUITABLE FOR TELEVISION.

SCREENED ⅜in. DIAM. Price **9d.** per yard, **8/6** per dozen yards, post extra.

SCREENED ⅝in. DIAM. Price **8d.** per yard, **7/6** per dozen yards, post extra.

TWIN BALANCED FEEDER. Price **5d.** per yard, **4/6** per dozen yards, post extra. Any length of cable cut to your requirements.

FOR CALLERS ONLY. EX A.M. TRANSMITTER-RECEIVER TYPE TR9. Battery operated. Supplied complete with all valves (a transmitting, 6 receiving). In wood transit case, etc. Dimensions height 9.2 M.c.

Owing to the varied condition of these sets we must offer them to callers only. The price varies from **45/-** to **£5 19/6.**

"THE VIEWMASTER." As exhibited at Radiotempa. Complete assembly instructions for building a 405 in 625 line television set.

A 40-page booklet packed with information on construction and other necessary data is supplied together with a full size working drawings, and stage by stage wiring instructions.

This receiver incorporates a brilliant black and white picture, with all the latest developments, and can be built from absolutely components. Data for London and Birmingham low available. ALL COMPONENTS IN STOCK.

PRICE **5 -** POST FREE.

EX. A.M. COMMUNICATION RECEIVER TYPE R1155. BRAND NEW IN WOOD TRANSIT CASE. Complete with 10 valves. Aerial tested before despatch. Circuit: R.F.C., A.V.C., R.F.AMP., I.F.P. stages, Magic Eye, etc. 5 wave bands (frequency range: 15.5-7.5 Mc/s; 7.5-3.0 Mc/s; 1,500-600 kc/s; 600-250 kc/s; 250-75 kc/s.

LASKY'S PRICE **£12 10 -** carriage (in transit case) 7/6 extra.

Full modification data and circuit details supplied free with each receiver.

Send a 3½d. stamp for a copy of our current stock list, giving full details of our Ex. Government radio and radar equipment, the Lasky's Radio Bulletin.

LASKY'S RADIO

370 HARROW ROAD, PADDINGTON, LONDON, W.9

(opposite Paddington Hospital)

Telephone: CUNningham 1979

Hours: Mon. to Sat. 9.30 a.m. to 6 p.m. Thurs. half day

D. COHEN

RADIO & TELEVISION COMPONENTS

Purchased from the liquidator of the Burgoyne Engineering Co.

MAINS TRANSFORMERS

Universal Replacement Type. Primary 230/250 v., 210-280 v. 60 mA., 6 v. tapped 4 v. 3 amp., 5 v. tapped 4 v. 2 amp., 6 v. 0.3 amp. **13/6**, plus 1/- post and packing.

350-350 v. 130 mA., 6 v. 5 amp., 5 v. 3 amp. Primary 230/250 v. **18/6**, plus 1/- post and packing.

Heater transformer, 6 v. 1½ amp. Primary 230/250 volts. **6/-**, plus 9d. post and packing.

Standard output transformer, 5000 ohm imp. **3/3**, plus 6d. P. & P.

Midget O.P. transformer, 5000 ohm imp. **2/9**, plus 6d. P. & P.

Smoothing choke, 10 Henry 80 mA. **3/9**, plus 6d. P. & P.

Smoothing choke. Midget, 40 mA. **1/11**, plus 3d. P. & P.

Line matching transformer. Pri. imp. 500 ohms. Sec. 15 ohms **10/-**.

ELECTROLYTIC CONDENSERS

2 mfd. 250 work. **9d.**

50 mfd. 50 work. **1/9.**

16-24 mfd. 350 work. **2/11.**

100 mfd. 12 v. work. **1/3.**

16-16 mfd. 450 work. **3/6.**

50 mfd. 12 v. work. **1/-.**

25 mfd. 25 v. work. **1/-.**

8 x 32 mfd. 450 work. **4/-.**

Midget tubular 12 x 12 mfd 450 work. **2/9.**

16 x 8 mfd. 450 work. **3/9.**

8 mfd. 450 v. work. **1/11.**

500 mfd. 6 v. work. **1/3.**

250 mfd. 12 v. work. **1/3.**

16 x 32 mfd. 450 v. work. **4/6.**

8 mfd. 500 v. BR 850. **2/6.**

16 mfd. 500 v. BR 1650. **3/6.**

8 x 8 mfd. 450 work. **3/3.**

30 x 30 mfd. 350 work. **3/9.**

P.M. SPEAKERS

Size	with trans.	less trans.
5in.	12/6	
6½in.	12/6	8/9
8in.	14/3	11/9
10in.	17/6	14/6
12in.		29/6

Post and packing on above items 1/- each extra.

ENERGISED SPEAKERS

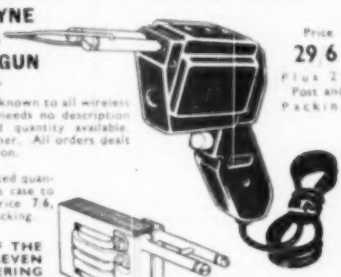
ROLA 6½in. 700 ohm field with O.P. trans. 5000 ohm imp. **11/6**

Less trans. **9/6**

8in. 2000 ohm field with O.P. trans. 5000 ohm imp. **15/6**

THE BURGOYNE SEVEN SECOND SOLDERING GUN

as illustrated.

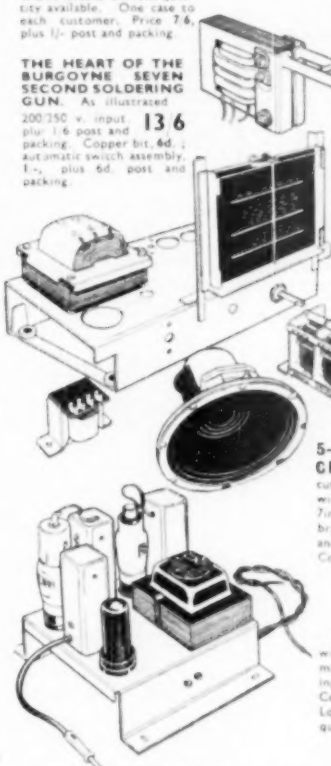


Price **29/6** Plus 2/6 Post and Packing.

This Gun is so well known to all wireless enthusiasts that it needs no description from me. Limited quantity available. One to each customer. All orders dealt with in strict rotation.

GUN CASE. Limited quantity available. One case to each customer. Price **7/6**, plus 1/- post and packing.

THE HEART OF THE BURGOYNE SEVEN SECOND SOLDERING GUN. As illustrated 200/250 v. input. **13/6** plus 1/6 post and packing. Copper bit, **6d.**; automatic switch assembly, 1/-, plus 6d. post and packing.



CONSTRUCTOR'S PARCEL as illustrated. Comprising 5-valve superhet chassis with transformer cut-out, size 13½in. x 6in. x 2in., with L.M. & S. scale, size 7in. x 5in. Backplate two supporting brackets, drive drum, pointer, two-speed spindle, twin gang condenser. Mains transformer 250/250 v. 60 mA., 6 v. 3 amp., 4 v. 2 amp. and 6½in. ROLA energised speaker with O.P. transformer. Complete, **25/-** Plus 1/6 post and packing.

5-VALVE SUPERHET CHASSIS with transformer cut-out, size 13½in. x 6in. x 2in. with L.M. & S. scale, size 7in. x 5in. Two supporting brackets, drive drum, pointer and three pulley wheels. Complete **6/6** Plus 1/- post and packing.

3-VALVE TELEVISION PRE-AMPLIFIER with own power supply. A.C. mains 200/250 volts. Slug tuned input, interstage and output. Complete with valves. For London or Birmingham frequency. Price **£4** plus 2/6 post and packing.

CONSTRUCTOR'S PARCEL, comprising chassis 10½in. x 5½in. x 2in., with speaker and valve holder cut-outs, ROLA 5in. P.M. with O.P. trans. twin gang with trimmers, pair of TRF coils, 4 International Octal valve holders and wave change switch. Price **17/6**, plus 1/6 post and packing.

SUPERHET COIL KIT, comprising medium and short wave coils, twin gang, pair of 465 IFs, 6 pole 3 way switch, 6 trimmers, two trackers and 5-valve superhet chassis with IF and speaker cut-outs. **14/6**, plus 1/- post and packing.

MINIATURE CHASSIS, size 8½in. x 3½in. x 1½in., miniature twin gang .00037, pair of miniature Wearite IFs, Type 400B, four B7G valve holders, frame aerial and medium wave osc. coil. **£1 9s. 6d.**, post and packing 1/6. Stamp for lists trade and retail.

TUNING CONDENSERS

.0005 twin gang with feet. **4/-.**

.0005 twin gang, fitted feet, trimmers and drum. **4/6.**

Midget .00037 twin gang. **6/-.**

Midget .00037 twin gang, fitted trimmers and Perspex dust cover. **6/6.**

.0005 tuning condenser. **2/3.**

Post on the above items, 6d extra.

PORTABLE CABINET

Grey mottle roxine covered leather carrying handle, scale and pointer, aerial wound on back. Size 12½in. x 10in. x 6½in. **28/-** plus 1/6 post and packing.

METAL RECTIFIERS

250 v. 125 mA. **4/3**, post 6d.

250 v. 60 mA. **2/6**, post 6d.

24 v. 4 amp. **18/6**, post 1/-.

MAINS DROPPERS

.2 amp. 1000 ohms tapped 900 ohms. **1/9**, post 3d.

.2 amp. 717 ohms, tapped 100 ohms. **1/6**, post 3d.

TRICKLE CHARGER

comprising transformer and metal rectifier, 230/250 v. A.C. mains, giving 12 v. ½ amp. **8/6**, plus 1/- post and packing.

WAVE CHANGE SWITCHES

6 pole 3 way. **1/2.**

3 pole 2 way. **1/2.**

6 pole 2 way. **1/2.**

5 pole 3 way. **1/2.**

WHITE KNOBS

12-sided, 1½in. dia., ⅝in. deep **3d.** each.

BROWN KNOBS

1½in. dia. **4d.** each.

POSTAGE STAMP TRIMMERS

50pf. **4d.** each.

VARIABLE TRACKERS

300 x 300. **9d.**

100 x 500. **9d.**

100 x 220. **9d.**

METAL BRAIDED WIRE

with PVC outer insulation, **6d.** per yard.

SILK COVERED SPEAKER BAFFLE

8in. x 6in. **9d.**

POST ORDERS ONLY

67 RALEIGH AVENUE, HAYES, MIDDLESEX

OUTSTANDING OFFERS FOR THE DISCERNING BUYER

BC312 RECEIVERS. In perfect condition. 230v. operation. Coverage 1,500 kcs.—18 mcs. in 6 Bands, **£22 10.** Carriage paid.

BC348 RECEIVERS. In perfect condition. 28v. operation. Coverage 200-500 kcs. and 1.5-18 mcs. in 6 Bands, **£18.** Two each only of the above sets available.

R1132A RECEIVERS. 11 valves 100-126 mcs. Grey cabinet, 19in. x 11in. x 10in. Brand new in original crates, **£4 19 6**, plus carriage 5/-. 12 only available.

R1355 RECEIVERS. 11 valves. As specified for the Inexpensive Television Receiver. Brand new, **63/-**, carr. 5/-.

ABK1 10-VALVE IFF RECEIVERS. Have 6 of 6SH7, 2 of 6H6, 2 of 7193, Motor Gen. with reduction gear, 3 relays etc. New condition, **20/-** each, carr. 5/-.

26 ARCS RECEIVERS (Similar to 454). 3-6 mcs. Brand new in sealed cartons less Dynamotor, **42/6.** (Dynamotors available if required, 28v., **17/-**), carr. 1/4.

BC433G RADIO COMPASS UNITS. Absolutely brand new and complete with 15 valves. 7 only **£7 10/-** each, carr. paid.

BC221 FREQUENCY METER. 1 only, brand new. Complete with spare set of valves, **15 gns.**, carr. paid.

906D FREQUENCY METER. 150-225 mcs. Resonance Meter. Brand new, in original crates. 3 only, **4 gns.**, each, carr. paid.

PLUG-ON POWER PACKS, for Command Receivers BC453/4/5. No alterations to wiring. Complete with rectifier valve **50/-**, carr. paid.

MODULATOR UNITS. Type 64. 7 valves, 2 VR91, CV73, CVB5, 2 VU133, VT604A, 3 Relays, 4.5mfd., 2,200v., 1.05 3,500, and many useful parts, **22/6** each, plus carr. 5/-. Unused.

EF50 VALVE HOLDERS. Finest quality. Brand new. **3/-** doz. Post 6d.

POWER UNITS PE94A. 28v. input. Output 300v. at 260 ma., 150v. at 10 ma., 14.5v. at 5 amps., **£3** each, carr. paid.

POWER UNITS. TYPE 10. Hoover manufacture. 24v. input. Output 300v. 120 ma., 150v. 10 ma., 6v. 5 amps., each **70/-**, carr. paid.

PAMPHONIC PA SPEAKERS. 10in. in handsome maroon metal cabinet. In original Makers packing (not surplus), **55/-** each. Less than cost.

MOVING COIL 5in. SPEAKERS. Brand new goods, **10/-** each. Post 9d

BC306 AERIAL TUNING UNITS. Aerial Variometer, 5 way Ceramic 3 pole switch, Porcelain lead through insulators, precision slow motion dial, 3,6000v. 80mmf. condensers, **10/-** each, carr. 1/4.

AIRCRAFT COMPASSES. Diameter 6½in. depth 4in. Perfect condition, **21/-**, carr. paid.

SCR522 TRANSMITTER CHASSIS. Less valves. (Modulation trans, choke and crystal switch included but not fitted), **19/6**, carr. 3/6.

VIEWMASTER TELEVISION RECEIVER PARTS FROM STOCK.

VIEWMASTER CONSTRUCTIONAL ENVELOPE FOR BIRMINGHAM, **5/4.** Post paid.

"INEXPENSIVE TELEVISION RECEIVER." Construction booklet, **1/9.** 6 page Conversion Data for 1155 Receiver, **9d.**, post paid.

MARCONI AUTOMATIC RECORD CHANGERS. Light-weight pick-up, complete with matching transformer, **£10 10 8**, carr. paid. Latest type.

PROMPT DELIVERY AND SATISFACTION GUARANTEED AS ALWAYS

2½d. stamped envelope must accompany all enquiries

LISTS AVAILABLE

H.P. RADIO SERVICES LTD.

Britain's Leading Radio Mail Order House

Estd. 1935

55 COUNTY ROAD, WALTON, LIVERPOOL, 4

Tel.: Aintree 1445 Staff Call Signs. G3DGL, G3DLV

Henry's

RADIO COMPONENTS ELECTRONIC & TELEPHONE EQUIPMENT

T.X. VALVES. Westinghouse 813 at **50/-**. 832 at **20/-**. 866A at **15/-**. Klystron 723A/B at **82/6**. 3E29 (829B) at **59/6**. All brand new and boxed.

E.H.T. TRANSFORMERS. Output 2,500 v., 5 mA. 4 v., 1.1 amps 2-0-2 v., 2 A (for VCR97). **35/-** only. Output 3,250 v. 5 mA. 6.3 v., 1 A. 2-0-2 v., 2 A. (for SCP1). **39/6**. Output 4,000 v., 10 mA. 2-0-2 v., 2 A. **48/-**. Output 5,000 v., 10 mA. 2-0-2 v., only **60/-**. All input 200/250 v. and fully guaranteed.

TRIMMER KIT. "Qualrad." An essential to every radio man. This famous kit can be supplied by us at **30/-** only! (List price **45/-**). Comprising: 1, 2, 4, 5, 6, 8 BA box spanners, 5 screwdriver trimmers (vertical and horizontal), 4 spanners, vane-setter, and thickness gauge. Attractively finished in white ivory. All neatly laid out in black crackle box. An absolute bargain!

MAINS TRANSFORMER. A special purchase from a leading manufacturer enables us to offer the following: 250-0-250, 70 mA., 6.3 v., 2 A., 5 v. 2 A., half-shrouded, drop-through type, with voltage adjuster panel. Absolutely brand new and guaranteed. **15/-** only, plus 9d. post.

R.1355 MAINS TRANSFORMER. 200/250 v. input. Outputs 250-0-250, at 120 mA., 6.3 v. at 6 A., 5 v. at 3 A. Fully shrouded top chassis mounting and guaranteed 100 per cent. Only **28/6**.

MINIATURE MAINS TRANSFORMER. 250-0-250, 60 mA., 6 v. 3 A., 5 v. 2 A., fully shrouded, well finished, size 3½in. x 3in. x 2½in. Price **21/-**.

RECEIVER TYPE 25. The receiver portion of the T.R. 1196. Covers 4.3-6.7 Mc/s and makes an ideal basis for an all-wave receiver, as per "Practical Wireless," August issue. Complete with valves types EF36(2), EF39(2), EK32 and EBC33. Supplied complete with necessary conversion data for home use. Only **22/6**. Chassis only, **8/6**.

6in. CATHODE RAY TUBES. VCR97, electrostatic, non-persistent, individually boxed, ready for transit. **35/-** each only. Postage and packing free.
Side contact base for above, **2/-**.
6in. Masks for above. Not ex-Govt. but specially manufactured to give rectangular picture. Black **6/6**. Stone colour, **7/6**.

VCR 139A C.R TUBES. Electrostatic 2½in., tested and guaranteed O.K. Only **18/-** each, plus 2/6 post and packing. Bases can be supplied at **2/-** each.

D.C. AVO MINORS. Special offer, limited quantity of these well-known instruments, unused but slightly soiled. Not ex-Govt., **55/-** only.

TYPE BC 624A RECEIVERS. Very good condition, by BENDIX, etc. Valve line-up: 12AH7, 12J5, 3 12SG7, 12C8, 3 9003, 9002, making 10 valves in all. Frequency coverage 100-156 Mc/s. Can be supplied at the absurdly low price of **25/-** (carriage and packing free).

AN AUTO-CHANGER for **£10 15/-** only, inc. tax. The very latest **COLLARO** Rim-drive auto-changer, complete with crystal pick-up. Very attractive appearance. A.C. 200/250 v., changes 10 records, either 10in. or 12in. Motor board size, 15in. x 12½in. Requires only 2½in. below, and 4½in. above.

NO. 18 SET. RECEIVER PORTION. A four-valve superhet receiver operating from 6-9 Mc/s (33m-50m). Valve line-up: 3 ARP12 (VP23), and AR8 (HL23DD). Requires only 144 v. H.T., 12 v. G.B. and 3 v. L.T., in perfect condition, only **17/6**, plus 1/6 packing and carriage. An absolute bargain. Suitable brand new headphones can be supplied at **3/6** per pair.

RECEIVER TYPE 21. The receiver portion of the WS.21 operating from 4.2-7.5 Mc/s. Incorporating B.F.O. and crash limiter. Valve line-up: 7 ARP12 (VP23), and 2 AR8 (HL23DD) plus spare valve of each type, making eleven valves in all. Only **35/-** complete.

SKV ELECTROSTATIC VOLTMETER. 0-5KV, panel-mounting, 3½in. scale, brand new, **59/-** each.

R1626 V.H.F. RECEIVER. Ex-A.M. Comprising 10 EF50 valves, 2 EB34, 24 v. rotary generator, relays, and hundreds of condensers and resistors. Complete in grey metal case. Absolutely brand new. **75/-** only.

METER DISTRIBUTION BOARDS. Comprising 0-300 v. M.I. meter, 3½in. A.C./D.C. input plug and socket, 3 output sockets, 2 porcelain fuses. Total size 12in. x 6in. Brand new and individually boxed. **17/6** complete.

POCKET VOLTMETER. Ex-Govt. Two range 0-15 v., 0-250 v., D.C. Brand new and complete in Web carrying case, only **10/6**.

MILLIAMMETERS. 0-1 mA. 2in. scale, square, moving coil, panel mounting, only **10/-** each.
0-1 mA. 2½in. scale, moving coil, panel mounting, **15/-** each. 0-5 mA. 2½in. scale, moving coil, two mounted on panel, **12/6** pair.

MICROAMMETER. 0-500 microa. 2in. scale, moving coil, panel mounting, **7/6** each.

Send stamp for current Components List. Probably the most comprehensive in the trade.

5, HARROW ROAD, LONDON, W.2

PADdington 1008/9

UNIVERSITY RADIO, LIMITED

Offer Guaranteed Used Equipment at Attractive Prices

Collaro Record-changer Unit, as new. (Mod. RC500) £8 10 0
Collaro Record-changer, Bar type, as new £12 0 0
Garrard Auto-changer, Model RC65, fitted with Decca FFRR head. As new. A.C. mains £12 10 0
MSS Recorder Unit, 1948 model, (disc). Complete less Amplifier, as new. Unused £30 0 0
V.G. Tracking Gear, brand new. A very fine job £8 0 0
AR88-LF, in perfect condition and working order £35 0 0
MCR-1, complete with coils, power-pack, 'phones, etc. As new £8 0 0
Eta Wave Coil Winder, (one only), hand wind—can be motorised. Complete with all accessories. As new £22 0 0
Taylor 65B Signal Generator, as new £11 0 0
Avo 1948 model Signal Generator, as new £10 10 0

Pam 25 watt Amplifier, 2 Pam speakers, in cabinet, with Pam Gramoplayer, M.c. mike and stand. 200/250 volts A.C. As new £37 10 0
Tungar 3 Circuit Charger, complete and perfect with rectifier valves £9 10 0
Hallicrafter's Sky Champion in perfect condition £18 10 0
R.M.E. 69, with Speaker, in perfect condition and working-order £19 10 0
Hallicrafter's S20R, in good working-order £14 0 0
Peto Scott Trophy 8, with speaker. Perfect £10 10 0
6 only Collaro Centre-drive 'Gram Motors, with turntables. New. Each £4 10 0
Collaro Standard Magnetic Pick-ups. New. Tax paid each £1 7 6
2 kVA. Auto-Transformers, 50 cycle, 115-230 volts. each £4 10 0

Avo model 40, as new, in leather case £12 10 0
Murphy Auto-change Radiogram, model A-139-R, unscratched. Cost 5 months ago (91/8/-). Our price £65 0 0
Avo latest model Signal Generator (wide Range) £17 0 0
Everett's Wee Meggars, 500 volts. Perfect £6 10 0
Crompton Ton. Tester, complete with 3 additional ranges up to 600 amps. As new £7 0 0
1155 Receiver, complete with power-pack and Magnavox speaker (66). As new £17 0 0
Collaro De Luxe Auto-change Microgram. As new £22 0 0
Muirhead Valve Voltmeter, type 3A. Perfect £10 0 0
R.C.A. Volt Ohmist Junior, 200-250 volts. A.C. Perfect £10 10 0
Romac 25 watt Amplifier, with built-in Radio Unit, M.C. Mike and Gram inputs. 200-250 volts A.C. As new £18 10 0

WE NEED GOOD USED EQUIPMENT URGENTLY. PLEASE SEND, BRING OR PHONE FOR OFFER

Avo Model 40, as new £11 10 0
Avo Valve-Testers, with Roller Panel, 1948 model as new £11 10 0
Hunt's Capacity & Resistance Bridge, model CRB, as new £11 0 0
Magnavox 66 Speaker, with built-in output transformer. Perfect £5 0 0
B.T.H. RK Senior Speaker, mains energised, 15 ohm Speech Coil. Perfect £3 0 0
Taylor Capacity & Inductance Adaptor, model 313C, as new £2 17 6
Weston (U.S.A.) Test-meter, Model E772. AC/DC. 20,000 O.P.V. in portable wood case. As new £15 10 0
H.R.O. Junior, complete with power-pack and all valves. Less coils. In perfect condition and working order £15 0 0
Howard Communication Receiver, model 640. 550 kc. to 43 mg., 4 bands. A.C. 200-250 volts, complete with S meter, all valves, Speaker, etc. In good condition and working order £21 0 0
BC342 & BC348, in perfect condition, with all valves, etc. each £15 0 0
Hallicrafter's Ultra Skyrider, complete and in perfect condition. A.C. 100-250 volts £19 10 0
R.M.E. DB20 Preselector, in perfect condition £8 10 0
National 1 to 10 metres Receiver, complete with power-pack, coils valves, etc. In perfect order £13 10 0
B.S.R. Audio Oscillator, model LSO, in perfect condition and working order. Cost £50 12 months ago. Our price £27 10 0
Davenset Dri-met 3 Circuit Charger, as new £17 0 0

2 kVA. Variacs, 50 cycle. As new. Each £10 10 0
New Ex-W.D. Rotary Convertor, 24 volt D.C. to 230 v. A.C. 1 phase, 50 cycle, 100 watts. Complete in metal case £5 0 0
E.D.C. Rotary Convertor, 220/240 D.C. to 230 A.C. 1 phase, 50 cycle, 180 watts. Complete in metal case with Filter Unit. Perfect condition £12 10 0
Ward Rotary Convertor, 50 v. D.C. to 240 v. A.C., 50 cycles, 1 phase, 140 watts, complete with Filter Unit. Perfect £9 0 0
Valradio D.C. to A.C. Convertor, 200 to 250 volts A.C., 75 cycle, 200 watts. In perfect condition £8 10 0
Another, at 50 cycle £8 10 0
B.S.R. Disc Recorder, complete with B.S.R. Amplifier, Ribbon Mike and Stand. Cost £248. Our price as new £135 0 0
M.S.S. Disc Recorder, complete with Amplifier and Play-back, in two portable cases, less mike and stand. As new £75 0 0
350 Twelve inch Classical Records, in portable cases. Each case containing 50 records. Not pre-war, all in perfect condition. To callers only, in lots of 50. Each 3 0
Panex Equipment 'Scope, as new £11 10 0
Taylor 'Scope, Model 30, Perfect condition £14 0 0
Vortexion Amplifier, 15 watts, 12 volt D.C. or 200-250 A.C. Moving coil Mike and 'Gram inputs. In metal case. As new £14 0 0
Ex-W.D. Ultra 'Scope, 200-250 volts A.C. Perfect condition £12 10 0

R-107 Chassis, complete with all valves, less speaker and metal cabinet. Perfect £7 10 0
1943 M.S.S. Disc Recorder Unit, in portable case, complete with Play-back Pick-up, less Amplifier. A.C. 200-250 volts. In perfect condition £22 10 0
Latest Model Hartley Turner Speaker, as new £6 10 0
Sound Sales Speaker, as new £5 10 0
Triplett (U.S.A.) Valve-tester and AC/DC Test-meter Combined, 110 volts A.C. Complete with charts, in perfect condition £12 0 0
Precision, as above £11 10 0
Cambridge Thermionic Voltmeter, Moullin pattern C. Perfect £8 10 0
E.M.I. Service Capacity Bridge. Perfect £6 10 0
1/16th H.P. A.C. Motors, Idex for recording, 200-250 volts. New each £1 12 6
B.P.L. Latest Model Super Ranger Test-meter. 1,000 o.p.v. AC/DC. As new £14 0 0
G.E.C. ½ kilowatt Fan Heaters A.C. 200-250 volts. Perfect. Each £6 0 0
Taylor 85A AC/DC Test Meter, as new £14 0 0
Taylor 47AP (Valve-Tester and AC/DC Test Meter Combined). As new £18 10 0
Taylor 90A, as new £10 10 0
Taylor 70A, as new £7 10 0
4 only G.E.C. M.C Mikes. Perfect. Each £2 0 0
R.S.A. Ribbon Mike, with Transformer and cable. As new £6 0 0
Shaftesbury Ribbon Mike, with transformer. As new £5 10 0
Vitavox M.C. Mike, in chrome case. As new £4 10 0

CASH OR CHEQUE WITH ORDERS. ALL ITEMS LISTED ARE CARRIAGE PAID

22 LISLE STREET, LEICESTER SQUARE, LONDON, W.C.2

'Phone GERrard 4447 and 8582. Hours 9 to 6. Thursdays 9 to 1.

K

VIEWMASTER T.V.

ANYONE CAN BUILD

Come and **VIEW** this **MASTER** of T.V. Construction. Full instructions and blueprints, $ each, plus 3d. postage.
Great improvements have been made on sound. Automatic interference suppression. 9-in. or 12-in. C.R.T. can be used. New type magnetic focus. Can be easily aligned without instruments. The requisite components are available from stock (postage extra).

	£	s.	d.
T.C.C. Capacitors	6	15	0
Westinghouse Rectifiers	3	2	6
Colvern Resistors		19	3
Morganite Resistors	1	6	9
Plessey equipment	5	12	6
E.R. parts	6	5	0
Belling & Lee accessories		7	6
Tag Strips		12	6

All valves available from stock.

THE FOLLOWING MANUFACTURER'S SURPLUS CAPACITORS AVAILABLE

ELECTROLYTICS

8μF 500V d.c. working	2 6
16μF " " "	3 3
32μF " " "	5 -
8- 8μF " " "	3 6
16-16μF " " "	5 6
32-32μF 450V " " "	6 6
8-16μF 350V " " "	4 -
8μF 350V " " "	2 -

Postage extra

ALEC Davis SUPPLIES Ltd.

WELL-KNOWN PICKUPS

Postage extra

	£	s.	d.
Connoisseur (no transformer)	3	19	0
Connoisseur G.P.10	2	10	0
Decca	3	15	5
Goldring 100	1	16	2
Goldring 121 (with sapphire—no transformer)	3	1	4
Marconi 14 (no transformer)	3	11	8
Shek Standard (brown)	2	10	4
" " (white)	2	15	6

All prices include Purchase Tax.

MAINS TRANSFORMERS (Postage extra)

By the well-known GRANGE TRANSFORMER PRODUCTS

	£	s.	d.		£	s.	d.
150-350V 100mA : 6V 4A; 5V 3A	1	12	6	5V 3A		10	6
300-300V 60mA; 6V 3A; 5V 2A		19	6	2.0-2V 2A		8	6
12V 1A		10	6	4V 2A		7	6
				40 watt Auto		12	6
				75 watt Auto		17	6

CHOKES (Postage extra)

	£	s.	d.		£	s.	d.
10Hy. 150 ohms 75mA L.F. Choke		4	9	15Hy. 150mA L.F. Choke		9	0
10Hy. 100mA L.F. Choke		9	0	15Hy. 80mA L.F. Choke		9	0
10Hy. 150 mA L.F. Choke		12	6	20Hy. 10mA 1,000 ohms		4	6
				20Hy. 50mA		5	6
				50Hy. 20mA 1,500 ohms		5	6

18 TOTTENHAM COURT ROAD, LONDON, W.1

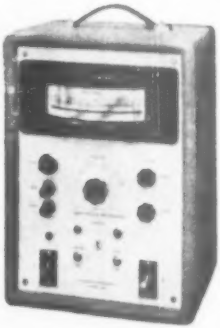
Tel: MUSeum 2453 Tel: MUSeum 4539

Shop hours: Monday to Friday 9—5.30 Saturday 9—1
FULL MAIL ORDER FACILITIES Please add postage

Instruments for Research and Industry

The TWENTY MILLION MEGOHMMETER

A new instrument for Research and Industry. Covers the entire resistance range from 0.5 to 20,000,000 megohms. Two test voltages, 85v and 500v, are provided. A six-inch mirror scale enables readings to be taken accurately and quickly. Designed for testing cables, resistors, capacitors and all insulating materials.



ELECTRONIC INSTRUMENTS LTD
17, PARADISE ROAD RICHMOND SURREY ENGLAND

Stop worrying about that metal work problem—there's always Ritherdon's!

This old established firm make Instrument Cases, Amplifier Racks, Fuse Boxes, Busbar Chambers, etc. to customers' specifications.

Experience has taught them that it costs no more to work to individual requirements than to produce standard lines. Bring that problem to Ritherdon's, all enquiries are welcome and will receive prompt attention.

RITHERDON & CO LTD

LORNE STREET, DARWEN, LANCS. Phone: Darwen 1028

Specialists in fine sheet metal work since 1895.

THE BURGOYNE AERIAL COAXIAL CONNECTOR

for EFFICIENT WATERTIGHT COAXIAL CABLE CONNECTIONS

Improves Signal Strength

This Connector provides both commercial and amateur users with a means of making efficient watertight coaxial cable connections for aerials. It also serves as centre insulator for a half wave doublet.

The Burgoyne Connector is made of aluminium with steatite insulation, and has two forged steel eyebolts equipped with convenient soldering connections. A tube of weatherproof cement plus the necessary assembly screws, are supplied with each connector.

Amateurs, and all listeners requiring perfect reception will welcome the Burgoyne Connector because it eliminates the necessity for crude, inefficient coaxial cable connections, thus saving them time and trouble due to the inroads of weather on home-made connections. Professional operators will find that it provides a quick, well-engineered means of doing an essential job.

Used on all maritime installations.

LIST PRICE REDUCED TO **12/3** each (*Post 9d.*)

TRIMMER KIT.

"Qualrad" An essential to every radio man. This famous kit can be supplied at **35/-** only! (List price 45/-). Comprising: 1, 2, 4, 5, 6, 8 BA box spanners, 3 screwdriver trimmers (vertical and horizontal), 4 spanner, vane setter and thickness gauge. Attractively finished. All neatly laid out in black crackle box.

DO *EVERY* SOLDERING JOB

Better, faster, cheaper with the—

BURGOYNE Instant-Heat SOLDER GUN.

MAKER'S LIST PRICE 79/6. OUR PRICE **52/6**
Post free

SAVE TIME ON SOLDERING!

Just press the button, count seven, and solder, and the bit will remain at soldering heat until you release the pressure when it cools off instantly.

No waiting to warm up or cool down—No element to burn out—No Mica to crack or splinter—No risk of shock. £10,000 was spent on the design of this famous tool! For A.C. mains 200-250 v.

EVERY SERVICE ENGINEER MUST have one!

A BLOCKED EXPORT ORDER makes this offer possible by an accident—the exporter missing the last boat to South Africa!

SPECIAL NOTICE.

This Solder Gun is offered to you in the original manufacturer's carton carrying their seal and we guarantee each Burgoyne Solder Gun for TWO YEARS. We cannot undertake to service or guarantee any gun purchased from any other source.

MOVING COIL HEADPHONES.

American type with padded ear cushions. Low resistance.

(*Post 9d.*) **4/11** pair

R.1355 RECEIVER I.F. TRANSFORMERS

6-7 m.cs. replacement units. Brand new **4** for **5/-** (*Post free.*)

FLEXIBLE COUPLINGS

By Eddystone and Wavemaster for ¼in. shafts **1/- each**, or **6** for **5/6d.**

BRASS SPINDLE COUPLERS.

For ¼in. shafts **3** for **1/-** or **12** for **3/9**

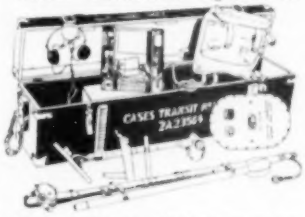
BOSTIK CEMENT.

Available in handy pocket-size tubes. Ideal for waterproof sealing. Price **1/-** per tube, or **6** for **5/-**. (*Add postage*).

COPPER SECTIONAL AERIAL RODS.

Each 12in. length—push into each other to build up to any length required. **4/-** for **24**
(*Postage and packing 9d.*)

METAL DETECTION EQUIPMENT.



For general detection of both ferrous and non-ferrous metal under ground or water or in timber, animals, etc., etc. An ex-government equipment which may be readily used for these purposes, offered at a fraction of the original manufacturing cost. Complete and new for only **79/6**

Carriage paid.
(22/6 extra for complete set of 5 batteries.)

Equipment: 3-valve battery amplifier in steel case, a shoulder haversack, two search coils with poles, junction boxes, headphones, 2 spare valves circuit diagrams, log book, connecting cables and sensitivity measuring stick, operating instructions. Ready for use as soon as batteries are connected. Packed in robust transit case.

M.O.S. RADIO-ALARM KIT.

A complete radio time switch in kit form which can be made in a few hours by anyone possessing the normal household tools. Be awakened to the strains of early morning music from your radio. Full wiring diagram and instructions included. The KIT **12/6**
(*Post free.*)

IVALEK De-Luxe CRYSTAL SET.

Complete in attractive cream or brown plastic cabinet with tuning scale. Fully guaranteed.

15/- (*Post 9d.*)

TELEVISION CONVERSION

A brand new 13 valve receiver incorporating 30 m/cs I.F. strip with band width of 4 m/cs, as well as RF Unit. Valves supplied 7 EF50; 2 EF54; 1 EC52; 1 VU39A; 1 HVR2 and 1 EA50. **52/-** in wooden transit cases.
(*Carr. and Pkg. 7/6*)

NOW LIGHT when you need it!

LONG BEAM FOCUSING TORCHES. American type.

These imported torches throw a beam of 700ft. Previously unobtainable on the home market for over 10 years, they now become available at a cost less than any non-focusing torch on the market. FULLY GUARANTEED

Type A (as illustrated) complete with BRITISH batteries and bulb ready for use. Solid brass nickel plated finish with adjustable Ring Focusing head. Pull out carrying loop in base. Spare bulb container. ONLY **15/11**
Post free.

Type B. As above but with **400ft. beam range.** ONLY **12/11** *Post free.*

Type G. As above, but small concentrated beam head, with **range of 600ft.** for **only 13/11** *Post free*

The demand is huge—orders in strict rotation.

HIRE-PURCHASE FACILITIES ON GRAM. MOTORS.

Collaro RC49 AC Auto Changer-Mixed. Crystal head	£14	6	8
Collaro RC500 AC Auto Changer-Non-mixer. Crystal head	£10	15	0
Collaro AC504 AC Motor and turntable with crystal head	£5	17	7
Collaro AC504 AC Motor and turntable with Mag. head	£5	3	2
Conrad. RUA AC Motor and turntable less head	£2	17	6

All the above (except Conrad) on H.P. terms: 33½ per cent. cash down with balance spread over 6 months.

Terms: Cash with order.

DIMMER SWITCHES.

Resistance 60 ohms. With on-off switch. Black moulded case fitted with engraved knob. Carries 1 amp. at 12v. Each **2/9**, or **6** for **12/6**
Post free

THIS MONTH'S SNIP.

Brand new and guaranteed P.M. SPEAKERS

3½in. **8/-** each.
or with grille **10/6.** Postage 9d. extra.

M O S NEWS LETTER

Packed with good ideas, circuits and bargains. Send 1/- for specimen copy or 5/- for a year's subscription.

MAIL ORDER SUPPLY CO., The Radio Centre, 33 Tottenham Court Rd., London, W.1 (Museum 6667-8-9)

RADIO EXCHANGE CO.

RECEIVER TYPE 18

RECEIVER TYPE 18. A four valve, battery superhet, covering 6-9 mcs. that only requires the addition of batteries to receive dozens of short wave stations! COMPLETE with four two volt valves, and a pair of matched headphones with jack plug. OUR PRICE 22/6

RECEIVER TYPE 21. The receiver section of the Wireless Set, covering from 4.0-7.0 mcs. and 18-31 mcs. with 8 two volt valves, BFO, crash finder, and vernier drive. Can be operated from 6v. L.T. and 120v. H.T. (required is a resistor from each filament lead permits 2v. L.T. operation. Complete with valves, circuit and connecting data. 35/-

VIBRATOR TYPE 21. The vibrator pack for the above receiver, contained in a metal case measuring 9 x 10 x 11, this unit will fit beneath the receiver, and plug for input, modelling the 6v. L.T. circuit of the receiver, will provide a small complete unit. ONLY 19/9

RECEIVER TYPE 3584. This unit includes Allotments EF37A, two EF91's, one EB35, one EF36, three EB91's and one EA50; a midget 8in. mirror, frames of resistors, condensers, pots, etc., would make this one of today's most alternative "buys." Set the "Pye" 45 mcs I.F. strip, which is ideal for London TV makes the unit a "must" for every amateur. BRAND NEW, in makers crates. £5 12 6 carriage paid

VELOCITY TYPE SPEAKERS. Extremely sensitive F.M. speaker units, which when loaded with a horn will handle 10 watts at real quality. 10 ohm impedance. ONLY £1

RECEPTION SET VRL

RECEPTION SET VRL. Made for Vancouver Radio Laboratories and covering 1.5-20 mcs in four bands, these superb receivers have never before been offered on the surplus market.

- 19 valves (6 x 6).
- Variable selectivity 'dial-filter.
- Noise limiter.
- R.F. gain control.
- A.F. gain control.
- Two speed indication of A.G.C.
- Magic eye.
- Built-in speaker.
- Full view dial.
- Crystal calibrator, providing "pips" every 10, 100 or 1,000 kcs.
- Provision for phones, with optional muting of internal speaker.
- Accessories built from top grade components.
- Set designed for 110v. input ... but we supply a suitable step-down transformer FREE.

PRICE £26 10/- carriage paid. Complete with 19 spare valves, £29 10/-

These units are in brand new condition, but were removed from their transit cases, by the Ministry of Supply, immediately prior to sale.

POWER UNIT TYPE 18. A rotary converter, delivering 0.6v. at 65 mA., and 215v. at 110 mA., plus a 230v. vibrator unit, both operating from 12 or 24 volts input, make this an ideal emergency or mobile power supply unit. OUR PRICE 12/6

TRANSFORMERS. Large modulation transformers, fully shrouded, and measuring 3 x 3 x 3 ins. These may be used as mains step-down transformers, providing a 7 x 7 ratio, and capable of handling some 15 watts. Price 6/- each

OUTPUT TRANSFORMERS. Multi-ratio output transformers, with a centre tapped primary, one high impedance sec. and one tapped low impedance sec., price 4/6

RADIO EXCHANGE CO., (W), 9 CAULDWELL STREET, BEDFORD. Phone 5563

All goods sold as used unless otherwise stated.

PLEASE WRITE YOUR NAME AND ADDRESS IN BLOCK LETTERS

The Revolutionary

GOLDRING

Headmaster

HYPERFIDELITY

PICK-UP

With an interchangeable Pick-Up Head for every type of record.

Supplied in attractive Display Carton complete with Goldring Tonaliser and Transformer

★

Goldring Products include

PICK-UPS, PICK-UP HEADS, SAPPHIRE JEWEL POINT NEEDLES, AND RADIOGRAM ACCESSORIES.

Write for full Descriptive Lists and Technical Information

ERWIN SCHARF

49-51a DE BEAUVIOR ROAD, LONDON, N.1

Telephone: CLISSOLD 3434

THE NEW B.P.L. SUPER RANGER

20 000 OHMS PER VOLT.

D.C. VOLTS: 100 mV to 5 kV

D.C. CURRENT: 1 μA to 1 Amp.

A.C. VOLTS: 0·5 V to 5 kV.

A.C. CURRENT: 10 mA to 10 Amps

RESISTANCE: 1 ohm to 2 megohms

OUTPUT: 0 to 62 db

METER: 5-inch Long arc, fitted with knife-edge pointer and mirror scale.

LIST PRICE: £22 - 15 - 0.

BRITISH PHYSICAL LABORATORIES

HOUSEBOAT WORKS, RADLETT, HERTS.

Tel. Radlett 5674-5-6

CHARLES BRITAIN (RADIO) LTD.

11 UPPER SAINT MARTIN'S LANE, LONDON, W.C.2

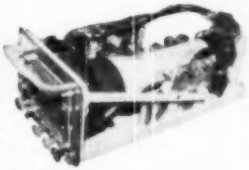
(Three minutes from Leicester Square, Tube Station. Up Cranbourne Street.)

Shop hours 9—6 p.m. daily (9-1 p.m. Thursday). Open all day Saturday. Temple Bar 0545

Best Buy at Britain's

RECEIVER R1084. A new consignment of these ever popular units just to hand. Valve line-up : 7 EF50, 2 EF54, 1 ECS2, 1 VU39A, 1 HVR2 and 1 EA50; and a 30 Mcs I.F. Strip. Superior to the R1355 for TV use as the power requirements are less, the 30 Mcs IF Strip has a band width of 4 Mcs, and no additional expense is incurred for the purchase of an RF Unit. Conversion data and circuits supplied for modification to the London Transmitter, but as the R1084 is a superhet it should be comparatively easy to modify for Sutton Coldfield. Brand New and packed in maker's crate, **59/6**, carriage paid.

INDICATOR UNIT 116H. Brand new and in impeccable condition and contained in manufacturers original wooden crates. A more up-to-date version of the famous 6A, and ideal for use in conjunction with the R1084 featured above. The contents include a VCR97 tube, 4 EF50, 3 EB34 and innumerable useful components associated with a super unit of this type. Unhesitatingly recommended for TV use. **£4/10/-**, plus 7/6 carriage and packing.



RECEIVER R1355. The now famous receiver unit specified in the "Inexpensive Television" booklet. Valve line-up : 8 SP61, 1 VR92, 1 VU120, and a 5Z4. In new and unused condition but slightly store soiled. Offered at only **59/6**, carriage paid. A limited number available.

RECEIVER R3118. 1½ metre superhet. Suitable as a vision amplifier. This unit has I.F.s of 12 Mcs with 4 Mcs bandwidth. Built-in power pack with tapped transformer for 180-240v. 50 cycles A.C. input. As it is a superhet will readily convert to Sutton Coldfield frequency. Complete with 15 valves : 6 SP61, 3 EA50, 2 EF54 and one each EC52, P61, 5Z4G and T63. **59/6**, plus 7/6 carriage. A bargain offer.

PYE STRIP FOR 45 Mcs. A complete vision receiver with 4 R.F. stages, Detector, Video Amplifier and Phase Splitter. Uses 6 EF50s and 1 EA50. Stripped from brand new equipment. Offered at **39/6**, less valves, post free, or complete with all valves, **67/6**.

SPEECH AMPLIFIERS. MADE BY R.C.A. 15 WATTS OUTPUT. VALVE LINE-UP : 4 6J7, 2 6L6, 1 5U4. INPUT 200-250v. A.C. 50-60 CYCLES. M.C. MICROPHONE INPUT, 15 and 500 OHM OUTPUT. ENCLOSED IN HANDSOME GREY CABINET 17in. LONG, 9in. HIGH, 11in. DEEP. THESE ARE BRAND NEW AND **OFFERED TO CALLERS ONLY FOR £13/10/-**. COMPLETE WITH ALL VALVES. A VERY SMALL NUMBER AVAILABLE.

BC624C RECEIVER. (Receiver portion of the SCR522). This particular version of this famous receiver contains a full size output stage (12A6). Supplied complete with modification instructions for 144 Mcs. use. Unused condition but slightly soiled, **25/-**, carriage paid.

Not just a Name—a Service!

WIRELESS SET No. 18. Battery superhet chassis. Frequency coverage 6 to 9 Mcs. Valve line-up : 3 ARP12 and 1 AR8 ; and 465 Kcs. I.F. Transformers. In new condition but store soiled, **18/6**, post free.

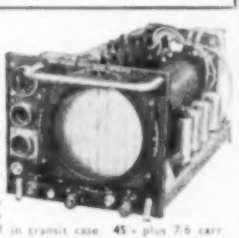
POWER UNIT TYPE 247. Housed in grey steel case size 11 x 9½ x 7½in., with chrome handles. For 230 v. 50 cycles A.C. mains operation. Output 600 v. at 200 mA. smoothed D.C. and 6.3 v. 3 amps. A complete power unit including a 5U4G rectifier for only **55/-** carriage paid. New in transit box.

AMERICAN I.F.F. UNITS. Supplied complete with 10 International Octal based valves and motor generator, which is easily converted to a motor running from either A.C. or D.C. 230 v. mains. Valve line-up : 6 6SH7, 2 6H6 and 2 7193 ; also incorporating reduction drive, carbon pile voltage regulator and crammed full of condensers, resistors and relays. In new condition. Only **25/-** each, carriage paid.

AMPLIFIER UNIT 18 165. A neat and compact equipment incorporating the following valves : 2 EF36, 1 EBC33, 2 EL32 ; and microphone transformers, intervalve transformers, countless condensers and resistors etc. Are you looking for something to "break down" ? Then here's your chance. An experimenter's gold mine for only **19/6**.

ADMIRALTY RECEIVER B36. A super communications receiver made by Marconi's Wireless Telegraph Company. Valve line-up : 2 R.F.s., freq. changer, 3 I.F.s, double diode triode, BFO and output pentode. Freq. coverage 1-20 Mcs. (15-300 metres) in 4 unbroken bands via turret coil change. Tuning and valve check meter incorporated. Sensitivity for 10 dbs signal to noise ratio—better than 1 microvolt. Filament transformer for 230 v. A.C. operation is included, but the H.T. supply is required. Valves required are : International Octal types 2 KTW61, 2 X65, 3 KTW63, 1 DH63, 1 KT63. Supplied complete with circuit diagram. New and in unused condition. A chance to buy a £100 receiver for only **£12/10/-** plus 10/- carriage and packing. Supplied less valves.

MULLARD RESISTANCE CAPACITY BRIDGE. (Type GM 4140/1) **Brand New.** Measures 10 pf. to 10 mfd. and 0.1 ohms to 10 megohms. A.C. Mains operation. ONLY **£8/19/6**, carriage paid.



INDICATOR UNIT 182A. Includes VCR517 tube and 8 valves as follows : 3 EF50, 1 5U4, 4 SP61 and 2 pot'meters, numerous condensers and resistors. Dimensions of case 18 x 8 x 7in. The C.R. Tube is stringently tested before despatch and the whole unit is in excellent condition. Forwarded in transit case. **45/-** plus 7/6 carr.

OUR STOCKS OF RADIO COMPONENTS AND EQUIPMENT ARE SO ENORMOUS AND VARIED THAT WE FIND IT IMPOSSIBLE TO ISSUE A COMPREHENSIVE LIST. WE CAN SUPPLY ALL YOUR REQUIREMENTS FROM A 1/20TH WATT RESISTOR TO A COMPLETE TRIPLE DIVERSITY RECEIVER. OUR PRICES ARE EXCEPTIONALLY REASONABLE. WHY NOT PAY US A VISIT ?

TELEVISION WITHOUT TEARS

OUR KIT OF PARTS (down to the last nut and bolt) is proving doubly popular because (a) the price of **£16/19/6** (carr. & pkg. 10/-) is amazingly low and (b) the explicit nature of our instructions and easy to follow point-to-point wiring diagrams ensures success for all. Its most convincing feature, however, is that the conversion of ex-government equipment is **NOT** involved.

The Televisor is built from standard radio components and assembled on two chassis, one for the Vision Receiver, Sound Receiver and Time Base, the other for the Power Supplies. It operates on A.C. Mains 200-250 volts.

Price of the comprehensive point-to-point wiring diagram and 17 pages of data is **5/-** post free. May we urge you to send for these initially. If a Kit is subsequently purchased the **5/-**, of course will be credited. PLEASE SPECIFY **LONDON OR SUTTON COLDFIELD** WHEN ORDERING DATA OR KIT.

NOTE THESE ★ FEATURES

- ★ NO KNOWLEDGE OF TELEVISION TECHNIQUE ESSENTIAL
- ★ ALL PARTS BRAND NEW, COMPLETE AND OF THE FINEST QUALITY.
- ★ ALL PARTS MAY BE PURCHASED SEPARATELY.
- ★ ROCK-STEADY PICTURE ASSURED BECAUSE SIX EF50 VALVES ARE USED IN THE TIME BASE AND SYNCH. SEPARATOR.
- ★ UNIQUE "AFTER SALES" SERVICE. (LONDON ONLY) TESTING AND ALIGNMENT OF RECEIVERS AFTER COMPLETION OF ASSEMBLY UNDERTAKEN FOR A NOMINAL SUM. **WE GUARANTEE RESULTS.**

OUR Televisor is equal to many commercial models. Come along during viewing hours for a demonstration.

"VIEWMASTER" KIT

NOW AVAILABLE FOR SUTTON COLDFIELD

THE SPECIFIED KITS OF COMPONENTS, AS UNDER, NOW IN STOCK. ENVELOPE WITH FULL CONSTRUCTIONAL DATA, **5/-** POST FREE. EVERY TECHNICAL ASSISTANCE, INCLUDING ALIGNMENT, (LONDON ONLY) WILL BE GIVEN TO CONSTRUCTORS PURCHASING THEIR KITS FROM US.

W.B. Chassis and Speaker Kit, including choke and transformer, etc., **£6/5/-**. T.C.C. complete condenser Kit, **£6/15/-**. Westinghouse Rectifier Kit, **£3/2/6**. Morganite resistor Kit, **£1/6/9**. Plessey Focus, Scanning Coils etc., Kit, **£5/12/6**. Colvern wirewound potentiometer Kit, **19/3**. Bulgin panel and switch Kit, **12/6**. Wearite Coils and Choke Kit, **£1/2/-**.

All makes of C.R. Tubes available. Prices : 9in. **£11/16/10**, inc. Tax. 12in., **£15/2/5**, inc. Tax.

All necessary valves available from stock.

Announcing the £15 T/V for the Midlands

Constructors in the Midland TV Area will be pleased to learn that the Data for our Mk. II Televisor for operation on the Sutton Coldfield Frequencies is now available. All constructors of this Televisor who have not yet received the information should write in quoting date of purchase and invoice number, when the full details will be supplied gratis.

This Televisor, many hundreds of which are in service, is designed round two Radar Units which cost only **£6** the pair. One unit is an Indicator containing a VCR97 C.R. Tube, and the majority of the valves and components, and the other unit is a ready made Vision Receiver which only requires modification for the TV Frequencies. Use of this latter item, which was made regardless of cost to a planned layout, eliminates many of the headaches experienced by those who have attempted the construction of a Vision Receiver from scratch. The Constructional Data is most detailed, with photographs, parts lists, circuit diagrams, etc., and costs only **7/6**, or is supplied gratis with the two Radar Units. Alternatively, it may be purchased, and the cost will be credited against the subsequent purchase of the Radar Units within 14 days. A fully detailed price list shows that the total cost is **£15/4/9**. Please note that orders for the Radar Units should include an additional **12/6** carriage costs; plus 10/- deposit on packing case.

For Constructors embarking on other circuits we can supply a wide range of component parts, many of which are listed below :—

RECEIVERS R1355. As specified for "Inexpensive Television." Complete with all valves, and a copy of the booklet (which can be supplied for **1/9**). ONLY **55/-** (carriage, etc., 7/6). unboxed, new condition.

RF UNITS TYPE 25 specified for London Area Station, **17/6** (postage 1/6). OR R1355 RECEIVER AND RF UNIT 25, **62/6** (carriage 7/6).

RF UNITS TYPE 26, specified for the Birmingham Station are now all sold, but we can supply the RF Unit 24 suitable for alteration, price as above, or brand new in cartons, **7/6** extra.

INDICATOR UNITS TYPE 6. The Indicator unit specified for "Inexpensive Television," this being complete with the VCR97 Tube and valves. BRAND NEW IN MAKERS CRATES. ONLY **90/-** (carriage 7/6).

TRANSFORMERS for above TV have been specially made as follows: Time Bases and Vision Transformer, 350-0-350v. 160 m/a, 5v. 3a., 6.3v. 6a., 6.3v. 3., ONLY **36/-**. Sound Receiver Transformer, 250-0-250v. 100 m/a., 5v. 3a., 6.3v. 6a., ONLY **27/6**. EHT Transformer for VCR97 Tube, 2-0-2v. 1.1a., 2-0-2v. 2a., EHT at 5m/a., **30/-**, postage 1/6 per transformer.

MAGNIFYING LENS for 6in. C.R. Tube. Brings up the picture size to approximately that given by a 9in. tube. ONLY **25/-** (postage 1/6).

SMOOTHING CHOKES. 10H. 80 m/a., **8/6**, 3H. 200 m/a., **6/-** (postage on each 9d.).

EHT CONDENSERS. 2,500 v., .1 mfd. oil filled tubulars **2/6** (post 3d.), 3,000v. .1 mfd. block paper size $3\frac{1}{2} \times 2\frac{1}{2} \times 3\frac{1}{8}$in. (inc. terminals), **4/6** (post 9d.).

CO-AXIAL CABLE, 75-80 ohms, **1/3** per yard.

PYE CO-AXIAL plug and socket, **1/-** pair or **6d.** each.

SPEAKERS. 10in. Truvox PM less transformer, **17/6** (postage, etc., 2/6).

CONDENSERS. 2 pf. to .1 mfd., mica, silver mica, or paper **6d.** each.

RESISTORS, ¼w. **4d.**, ½w. **5d.**, 1w. **6d.**, 2w. **9d.**

CWO please. Add postage where not stated on orders under £2.

U.E.I. CORP., The Radio Corner

138 GRAY'S INN ROAD, LONDON, W.C.1

(Phone: TERminus 7937)

Open until 1 p.m. Saturdays, we are 2 minutes from High Holborn and 5 minutes from King's Cross.

BAKERS 'Selhurst' RADIO

PIONEERS OF MOVING COIL SPEAKERS SINCE 1925

NEW "HIGH FLUX" 1950 MODELS

HIGH FIDELITY SPEAKERS

The World Famous 12" triple cone 12.B.

The standard 12" P.A. model 12 C.

The Cinema Model 18" "Duplex" C.T.

Write for Illustrated list and technical details of SPEAKERS, TUNERS and AMPLIFIERS.

BAKERS 'SELHURST' RADIO

Dingwall Road, Croydon

Telephone: CROydon 2271-2

'TECHNICAL EXCELLENCE'—

—combines with beauty and soundness of DESIGN in the

OXLEY

AIR DIELECTRIC TRIMMER

Type approved Cat. A No. 404.

Width: 15.5 m.m. Length: 22 m.m. Height: 1.5 to 8pF—7.5 m.m. 1.8 to 20pF—10 m.m. 2 to 26pF—11 m.m. 2 to 32pF—12m.m. Law: Straight line capacity. Power Factor: Less than .001. Insulation: Over 2,000 megohms. Voltage: 500 D.C.

OXLEY DEVELOPMENTS CO. LTD.

ULVERSTON NORTH LANCS. TEL.: ULVERSTON 3391

RADIOMENDERS LIMITED

FOR SPECIAL TRANSFORMERS AND REWINDS

We specialise in

AMATEURS' WINDINGS, TRANSFORMERS ALL TYPES, CHOKES, PICK-UP COILS, INSTRUMENT COILS, Etc.

Highest workmanship **Good Delivery**

☆

RADIOMENDERS, LTD.

Television & Radio Apparatus, Transformer & Coilwinders.

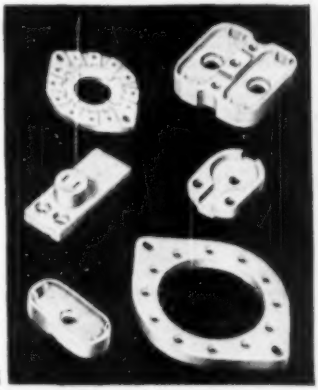
123-5-7 Parchmore Road, THORNTON HEATH, SURREY

LIV 2261. Trade enquiries invited. Established 16 years.

Your designs

LET US BRING THEM TO

LIFE!



Made in Three Principal Materials

FREQUELEX
An insulating material of Low Di-electric Loss, for Coil Formers, Aerial Insulators, Valve Holders, etc.

PERMALEX
A High Permittivity Material. For the construction of Condensers of the smallest possible dimensions.

TEMPLEX
A Condenser material of medium permittivity. For the construction of Condensers having a constant capacity at all temperatures.

the most difficult problems solved by . . .

Bullers

BULLERS LOW LOSS CERAMICS

BULLERS LTD., 6, LAURENCE POUNTNEY HILL, LONDON, E.C.4

Telephone: Mansion House 9971 (3 lines) Telegrams: "Bullers, Cannon, London"

A COMPLETE RANGE OF TELEVISION COMPONENTS

- Line and Frame Scanning Assemblies.
- Focus Coils and P.M. Focus Units.
- Line and Frame Output Transformers.
- Line and Frame Oscillator Transformers.
- Combined Line Output transformers and E.H.T. Generators.
- Width controls.
- Video correction chokes.
- Filament transformers, E.H.T. transformers and Smoothing chokes.

Allen Components are specified for the Electronic Engineering Home Televisor and the range includes components suitable for use in all of the popular Home Constructor Sets.

ALLEN COMPONENTS LTD.

1 Shrewsbury Road, Stonebridge, London, N.W.10

Telephone: WILlesden 3675 and 4901.

G2AK **This Month's Bargains** G2AK

G.P.O. Standard Desk Microphones with screened lead and plug, 9/6 each, plus postage 1/6.

H.R. Headphones, 8/6 per pair.

Moving-coil Hand Microphones with switch, 3/11. Transformer for above, 2/-.

500 Microamp Meters. Scaled 0-600. 5/- each.

Microphone Tester. In smart teak case 7in. x 5in. x 3in., contains three jacks, mike transformer, terminals, sockets, etc., with 0-10v. rectifier-type meter, 1,000 ohms per volt. **17/6** plus 1/6 post and packing.

B.C.610 Tuning Units. Contains host of parts. Var. condensers, switches, coils, sockets, etc., 5/- each, plus 1/- postage.

Meter Oscillator Units, Type 123. This consists of a silver-plated box 6in. x 3in. x 3in. containing a rotating coil of 50 turns on a 1½in. x 3in. former driven by a J.B. type 5 to 1 reduction drive fitted with a 0-100 engraved dial. Given away at 5/-, plus 1/- postage.

T.U. Units. Most types. New in boxes, **10/- each.**

Co-Ax Cable, 70 ohm, ¼in. dia., per yd., **8d.**

300-ohm Twin-Ribbon Feeder, per yd., **5d.**

13ft. ¼in. dia. Co-Ax fitted Pye Plug each end, **2/6.**

.01 5,000v. Tub. Condenser with mounting feet, **1/6** each. .02 8,000 v. as above, **2/-** each.

Station Log Books. 200 pages printed one side only. Size 8½in. x 11in. First-class paper and bound with heavy cover. Price **17/6**.

Carriage paid on all orders over **£1** except where stated. Please include small amount for orders under **£1**.

PLEASE PRINT YOUR NAME AND ADDRESS

CHAS. H. YOUNG, G2AK

All Callers to *110 DALE END, BIRMINGHAM*

Mail Orders to *102 HOLLOWAY HEAD, BIRMINGHAM*

Telephone: MIDLAND 3254

G. W. SMITH & CO., (RADIO) LTD.

TELEVISION. Ex-R.A.F. type 208 Amplifier units, complete with 2 E.F.50 valves. Ideal as Pre-Amplifier for both Vision and Sound, with full conversion instructions for sound and vision, **19/6** each.

Transmitter Units, type T.U.8. Nos. 5, 6, 7, 8, 9, 10 and 26 complete with cabinet, **15/-** each.

B.C. 455 Receivers, complete with valves, **22/6** each. **B.C. 454** ditto, **25/-**. **B.C. 453, 39/6.**

Television High Voltage type Mansbridge Condensers, "TROUBLE FREE": 1,3000 v. **2/-**; 1,4000 v. **3/-**; 1,5000 v. **3/3** each.

Transformers, Adm. Pattern, 230 volt 50 cycle. Primary. Secondary, 700 volt 20 M/a. Filaments Tested at 5000 volts, 2 of 4 volt 1.25 amp., ideal transformer for 'scope unit. **17/6** each. Brand New and Boxed.

Filament Transformers, Ex-W.D. 230 volt primary 6.3 volt C.T. 1-5 amp. **10/6** each.

Filament Transformers, Ex-W.D. 230 volt primary 5 v. 3 amp., 6.3 v. 1.25 amp. twice, 6.3 v. .6 amp. **12/6** each.

Television Condensers, 1000 pf., 500 pf., midget moulded, mica, **4d.** each. .001 mfd. 5000 v. mica **1/3** each. .001 mfd. 9000 v. **1/3** each, .001 mfd. 15000 v. **1/6** each.

Open All Day Saturday.

3 LISLE STREET, LONDON, W.C.2

Phone: GERRARD 8204

THE IDEAL MICROPHONE FOR TELE-COMMUNICATION

MODEL **C 51** MOVING-COIL MICROPHONE BY

Designed and developed essentially for G.P.O. hand-sets, with mobile tele-communication and P.A. work in view, LUSTRAPHONE Model C 51 is fast establishing itself wherever a good microphone is called for. It provides maximum intelligibility at extreme range and under adverse conditions, and is used extensively by Broadcast Engineers and others needing quality and dependability. Available as insert unit, or complete hand instrument. Data sheet on request.

LUSTRAPHONE LUSTRAPHONE LTD. 84, BELSIZE LANE, N.W.3

THE *Fidelia* LUXURY 7-VALVE RADIOGRAM CHASSIS

Features invisible variable selectivity, infinite impedance detector, electronic tone and treble controls, triode output stage, 5 waveband 16-58, 190-550 and 1,000-2,000 metres. Audio oscillator superior to 14 inch cones, bass cones and whose controls operate on mains, suitable 3in 15ft; weight 4 lbs. Introductory 18 months Price £12-12-6

Data Sheets on request, also for "Prestige" Complete Chassis, £12-17-6; 3 R.P. Series 8 watt amp. £14-10; 5 watt amp. £19-12.

ELECTRO *Acoustic* DEVELOPMENTS 18 BROAD RD., WILLINGDON, S.X.

RELAYS AND KEY SWITCHES

LARGE EX-GOVT. STOCKS

IMMEDIATE DELIVERY

Types 600-3000 Relays — Siemens High Speed Uniselector Switches, Carbon Insets, Telephone Components, Plugs, Jacks, Handsets, Co-Axial Cables.

JACK DAVIS

Dept. W.

30 PERCY STREET, LONDON, W.1

Phones: MUSeum 7963, LANgham 4821

KERSHAW'S KORNER KALLING!!!

T.V. AMATEURS

BARGAINS IN GOVERNMENT SURPLUS ELECTRONIC TELEVISION COMPONENTS

MODULATOR TYPE 20 consisting of 2 valves VU111, 4 volt 5kV E.H.T. rectifiers, 5 valves type KT44 (very suitable for line output), and 1 valve type MH41. This modulator is a marvellous unit for spare parts and is offered for the very low price of **42/-** inc. carriage.

RCR.351S. I.F. strip (3.5 Mc/s, ideal for "W.W." Televisor. 6 I.F. stages with 3 Mc/s band width. EA50 Detector and EF39 Video O.P. Our price, **30/-** each, complete with valves.

INERT 1.5 v. CELL BATTERIES, long life, fill with plain water and have continuous use. Ideal for every purpose. 3 for **2/6**. Post paid.

All Goods post paid. No lists or Catalogues.

S. KERSHAW

KERSHAW'S KORNER, PERSHORE STREET, BROMSGROVE STREET, BIRMINGHAM 5.

Phone Midland 4282-7097

SOUND & VISION KIT

21 Valves. Suitable for 9in., 10in. and 12in. Magnetic Tubes. Less Tube, tube holder and Mask. Chassis all stamped out.
State whether for Sutton Coldfield or Alexandra Park. Complete with booklet, instructions, etc. **£21 12s. 6d.** carr. paid.
Pre-Amplifier de Luxe. Consisting of power pack and two R.F.s. Built up and enclosed in case. **£7 12s. 6d.** carr. paid.
Small Pre-Amplifier. No power pack. **42s. 6d.** carr. paid.
Co-Axial Aerial. 75 ohms. **1s. 6d.** per yd. All new.

MAINS TRANSFORMERS, FULLY INTERLEAVED, SCREENED AND IMPREGNATED. ALL PRIMARIES ARE 200/250 v. Half Shrouded.

HS61. Output 250/0/250v. 60 m/a. 6.3v. at 3 amps. 5v. at 2 amps. 15/6
HS40. Windings as above. 4v. at 4 amps. 4v. at 2 amps. 15/6

Output
HS2. 250/0/250v. 80 m/a. 17/6
HS30. 300/0/300v. 80 m/a. 17/6
HS3. 350/0/350v. 80 m/a. 17/6
HS2X. 250/0/250v. 100 m/a. 19/6
HS30X. 300/0/300v. 100 m/a. 19/6
HS3X. 350/0/350v. 100 m/a. 21/6

Fully Shrouded

Output
FS2. 250/0/250v. 80 m/a. 19/6
FS30. 300/0/300v. 80 m/a. 19/6
FS3. 350/0/350v. 80 m/a. 19/6
FS2X. 250/0/250v. 100 m/a. 21/6
FS30X. 300/0/300v. 100 m/a. 21/6
FS3X. 350/0/350v. 100 m/a. 21/6
All the above have 6.3-4-0v. at 4 amps., 5-4-0v. at 2 amps.
FS43. Output, 425/0/425v. 200 m/a. 6.3v. 4 amps. C.T. 6.3v. 4 amps. C.T. 5v. 3 amps. Fully shrouded 42/6
FS50. Output, 450/0/450v. 250 m/a. 6.3v. 2 amps. C.T., 6.3v. 4 amps. C.T. 5v. 3 amps. Fully shrouded 62/6
F30X. Output, 300/0/300v. 80 m/a. 6.3v. 7 amps. 5v. 2 amps. Framed, flying leads 26/6
F35X. Output, 350/0/350v. 250 m/a. 6.3v. 6 amps. 4v. 8 amps., 4v. 3 amps., 0-2-6.3v. 2 amps. Fully shrouded 59/6
FS160X. Output, 350/0/350v. 160 m/a. 6.3v. 6 amps. 5v. 3 amps. Fully shrouded 37/6
FS43X. Output, 425/0/425v. 250 m/a. 6.3v. 6 amps. 6.3v. 6 amps. 5v. 3 amps. Fully shrouded 57/6
HS6. Output, 250/0/250v. 100 m/a. 6.3v. 6 amps. C.T. 5v. 3 amps. For receiver R1355. Half shrouded 24/6
HS150. Output, 350/0/350v. 150 m/a. 6.3v. 3 amps. C.T. 5v. 3 amps. Half shrouded 25/9
F36. Output, 250/0/250v. 100 m/a. 6.3v. 6 amps. C.T. 5v. 3 amps. Half shrouded 25/9
FS120. Output, 350/0/350v. 120 m/a. 6.3v. 2 amps. C.T. 6.3v. 2 amps. C.T. 5v. 3 amp. Fully shrouded 27/6
The above have inputs of 200/250v.

FILAMENT TRANSFORMERS

F4. Output, 4v. 2 amps. 7/6
F6. Output, 6.3v. 2 amp. 7/6
F66. Output, 6.3v. 6 amps. 5/3
F6X. Output, 6.3v. 3 amps. 5/-
F12. Output, 12.6v. tapped 6.3v. at 3 amps. 15/6
F24. Output, 24v. tapped 12v. at 3 amps. 21/6
F12 and F24 framed with Flying Leads.
FU6. Output, 0-2-4-5-6.3v. at 2 amps. 9/-
F29. Output, 0-2-4-5-6.3v. at 4 amps. 15/-
FU6 and F29 clamped with Flying Leads.
F5. Output, 6.3v. at 10 amps. 5v. at 10 amps. 12.6v. at 5 amps. 10v. at 5 amps. 31/6
F6/4. Output, four at 6.3v. tapped at 5v. at 5 amps. per winding, giving by suitable series and parallel connections 24v. at 5 amp., 20v. at 5 amp., 18v. at 5 amp., 15v. at 5 amp., 12.6v. at 10 amp., 10v. at 10 amp., 6.3v. at 20 amp., 5v. at 20 amp. 47/6
F5 and F6/4 framed with Flying Leads

OUTPUT TRANSFORMERS

MOP1. Ratios 26, 46, 56, 66, 90, 120-1 50 m/a. max. current. C.T. for Q.P.P. Class B, etc. Secondary 2/4 ohms. Top panel and clamped ..... each 5/-
OP1. Midget Power Pentode, ratios 30, 60, 90-1, 40 m/a., Secondary 2/3 ohms. ..... each 3/2
OP2. Midget Pentode, ratios 45-1, Secondary 2/3 ohms. 40 m/a. ..... per doz. 33/-
OP10. 10/15 watts output. 20 ratios on Full and Half primary 16/3
OP30. 30 watts output. 20 ratios on Full and Half primary 23/9
Williamson's O.P. Transformer to Author's specification **£3/12/6**
Chokes for Williamson's Amplifier. 30H at 20 m/a., **15/6**; 10H at 150 m/a. 29/6
C.W.O. (add 1/- in £ for carriage), all orders over £2 carriage paid.

H. ASHWORTH
(Dept. W.W.)
676 GT. HORTON ROAD
BRADFORD, YORKS.

A NEW

FIELDEN TECHNIQUE

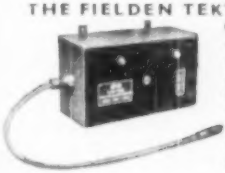
in micro - measurement and control

FOR ANY INDUSTRIAL OR RESEARCH PROBLEM RESOLVABLE INTO MINUTE ELECTRICAL CAPACITANCE CHANGE

ACTUATION BY PROXIMITY of solid or liquid conductors or insulators to an electrode terminating a co-axial cable.

THE FIELDEN PROXIMITY METER—SENSITIVITY 0.01 mmf—indicates minute capacitance changes, whether caused by very small mechanical displacement or dielectric change. It measures, for instance, strains in structures, it gauges components to less than 0.00001in., monitors sheet, foil and wire sizes, measures liquid and other levels precisely, monitors dimensions and compositions, compares dielectric properties of non-conducting liquids etc. It does what is impossible mechanically and, in many fields, surpasses all other micro-measurement methods.

THE FIELDEN TEKTOR—SENSITIVITY 0.25 mmf — is a unique, stable, high-speed capacity relay which solves many problems of counting, temperature control, level control of liquids and solids, and so on where simple direct-switching is impossible.



Please send for specification FE/4 to the **SPECIALISTS IN INDUSTRIAL ELECTRONIC EQUIPMENT**

Fielden

ELECTRONICS LIMITED
HOLT TOWN · MANCHESTER
Telephone ARDwick 2619

MIDLAND INSTRUMENT CO.

FOR GOVT. SURPLUS STOCK, ETC.

MAGSLIP MOTORS, this transmitter MX-2, two of these motors can be wired in series for 110v. or in parallel for 55v. A.C. single phase; in this way, when the shaft of one motor is turned, the other will follow in perfect step, clockwise or anti-clockwise, (ideal where a perfectly synchronised remote control is required. Motors are sealed, 50 cycle, 110v. 45w., weight 4 lbs., size 4 ins. long 3½ins. shaft, manufacturers price 70/-, our price 15/- each, post 1/-. **CROBERT RIVETERS TYPE "R"** an automatic hand tool for repetition placing of tubular rivets (blind), takes approx. 40 rivets in magazine, complete with two of each, Rivet mandrels, also other spares, instructional Booklet, issued in good cases, size 23 x 6 x 8ins., worth £15, our price £7/-, post 3/-. **TYPE 11 RECEIVERS**, 5 band, 4.5 to 7.5, and 19 to 31 Mc/s, contains 11 valves, ARP12 VP23 (2), ARP HL21DD (4), also Mallory type 650 fc vibrator, also medium drive and dial engraved in Mc/s, with other mechanic, chassis complete with side protection frame, size 9½ x 8½ x 6ins., designed for fit operation, complete with data for converting to 2v. L.T. supply operation, unused condition, £7 6, post and packing 3/6 extra. **TRANSFORMERS**, input 230v. 50 cycles, outputs 6.3v. at 10 m.a. (here is windings at 1.75 amp., also 6.3v. at 1 amp., all terminations engraved), 2½ins. high, 2½ins. square, weight 4½ lbs., new boxed, worth 30/-, our price 15/-, post 1/-. **CHOKES**, 100 H. at 10 m.a., 3.000v. R.M.S., weight 11 lbs., brand new boxed, 5/-, post 1/-. **TELEPHONE CABLE D6**, twin twisted rubber covered and twisted round steel, wound on wood drums, new unused, 25/-, carriage 5/-.

MAINS TRANSFORMERS, [illegible]

FLEXIBLE DRIVES, approx. 2m. inner spiral metal casing, with male fitt. screw fitting, suitable for light power transmission, speedometers, remote control, etc., 2/6 (Special price 1/3), 1 ft. 2/6, 3ft. 3/6, 4ft. 4/6, 12ft. 5/6, all new stock, post 9d. **HOOVER BLOWER MOTORS**, reliable for 200/250v. A.C. intermittent duty, suitable are [illegible] and vacuum cleaner, [illegible] powerful air delivery at vacuum, unused, 15/-, post 1/-. Ditto dual voltage 110 or 230v. A.C./D.C. 15/-, post 1/-. **ASTROGRAPHS U.S. PATTERN**, designed for producing star charts, complete with [illegible] lamps, tools and instructions, in very smart and useful wood case, hinged top, plated chase and corners, leather carrying handle, size 14 x 11 x 10ins., new unused 12/6, carriage 2/6 (the cases only are worth this). **EX-G.P.O. TELEPHONE STANDS**, black bakelite, complete with handset, handset or bell stopper, 4 cord, new condition, supply of 6 or over only, new unused 8/-, post 1/-. **TELEPHONE HANDSETS**, modern bakelite type, fitted 4 wire cord and 4-pin plug, new boxed, 10/-, post 1/-. These are suitable for use with above telephone stands. **HOOVER INDUCTION MOTORS TYPE S.P.201**, shaded pole type, 230/250v. A.C. mains only, suitable for extra-quiet [illegible] 1,500 r.p.m., size 3ins. long, 2ins. dia., fitted 1ins. long dia. shaft (the shaft motor for 1/3 size, brand new boxed, 20/-, post 9d. **BATTERIES**, sealed and unused, guaranteed by the first grade 1948 manufacturer, 120v. H.T., plus 2v. L.T., size 7½ x 5½ x 3½ins., 6/-, post 1/-. 2v. H.T. plus 1½v. L.T., size 3½ x 2½ x 2½ins., 5/-, post 9d. **SELECTOR SWITCHES**, 12 to 24v. D.C., will motor and stop at any of 4 Yaxley type switch positions, unused 3/6, post 9d.

(Not new 1000 lots, with bakelite in new items, will be available shortly - send 6d. for a copy. [illegible] are recorded for the time being.

MOORPOOL CIRCLE, BIRMINGHAM, 17

Tel.: HARborne 1308 or 2664

PRATTS RADIO

1070 Harrow Road, London, N.W.10

Nr. SCRUBBS LANE. Tel. LADbroke 1734.

MODEL AC10E £8 18 6

AMPLIFIERS. College general purpose units. **Model AC10E** 10 watt 4 valve unit. Neg. feedback. Separate Mike stage, separate inputs for mike and gram with twin faders. Tone control. Complete in case with chrome handle, **£8 18 6.** (Carriage 5/- extra).

Model AC18E, 6 valve unit with output of 18½ watts. Push-pull output with feedback over 3 stages. Separate mike stage. Inputs as AC10E. Twin faders and tone control. Complete with case and chrome handles, **£13 19 6.** Carr. Paid. **Model U10E**, 6 valve unit for DC/AC mains, specification as AC18E. 10 watts output with feedback over 3 stages. Separate mike stage. **£11 11/-** (carriage 5/- extra). All above have outputs to match 3, 8 or 15 ohm speakers, and are ready for immediate use. Input volts average, mike .001, gram. 3 v. No preamplifier required. **Model AC8C**, Record Radio amplifier, 5 valves P.P. output with feedback over 3 stages. Output 8 watts. Chassis model. Supplies H.T., L.T. for tuning unit. Output to 3, 8 or 15 ohms speaker, **£9 18 6.** Carriage paid. **Model AC4C**, A.C. or **U4C**, AC/DC, 3 valve chassis units. 4 watts to 3 ohms, **£4 19 6** (carr. 2/6 extra). Stamp for fuller details.

TRANSFORMERS. E.H.T. 2,500 v. 5 mA. 4 v. 1½ A., 4 v. 2 A. C.T. (for VCR97) input 200-240 v. (in 10 v. steps) **27 6**; 2 x 350 v. 6 v. 6 A. 5 v. 4 A. 4 v. 3½ A., **35/-**; 2 x 350 v. 80 mA., 6 v. 4 A., 5 v. 2 A., **22 6**; Heavy-duty output, 30 watt 10 ratio (20-1 to 140-1 C.T.), **23 9**; Ultra midget for 154, 354 etc., **3/11.** Filament 115/230 v., 6 v. 2½ A., **7/6.** All above are new manufacture, not surplus.

SPEAKERS. Truvox 2½in., **17 6**; 8in., **14 6**; 12in., **37 6**; Rola 5in., **10/-**; 12in. **130/-**; Plessey 8in., **11 9**; 10in., **18 6**; Rola Mains En., 8in. 700 ohm, **19/-**; Goodman's 8in. P.M., **16 6**; 10in. **28 6.**

CONDENSERS. 8.1, 500/550 v. C/b'd. Blocks, 8 mfd. **3/3**; 8 + 8, **4/9**; 8 + 16, **6/-**; Midget 450 v. Can type, 16/-; 8, **3 9**; 8 + 8, **3 6**; 16 + 16, **6/-**; 25 mfd. 25 v. **10d.**; 2 mfd. 350 v. **1/-.**

VARIABLE CONDENSERS. 2 gang .0005, **4/3**; 3 gang, **6/9**; with feet and long shaft, presents 50pf. ceramic **4d.**; 100 and 500pf., **1/3.**

MISCELLANEOUS. Ceramic U.S. octal bases, **5d.**; Paxolin, **4d.** Volume controls, all values, 5K to 2 meg., w/switch, **4/6**; less switch, **2/9.** Voltage droppers with ft. and 2 sliders, 3 A., 800 ohm or 2 A., 950 ohm, **4/6**; Chokes (not W.D.) 160 mA. 20 Hy. 400 ohm, **6/6**; 90 mA. 10 Hy., **10/6**; 150 mA., 10 Hy. **14/3.** Bulgin Jack sockets, **1/6**; Plugs, **9d.**; Wearite "P" coils, **3/-** each. Wearite I.F.'s Standard **10/-** each. Open 10-6. Callers very welcome.

All Goods New and Unused. C.O.D. or C.W.O. Post Free over £1.

FT.300 TRANSMITTERS Manufactured by Federal Telephone & Radio Corp. U.S.A. Four RF units operating on C.W. simultaneously at 3 kW output each. 2 Mc to 20 Mc.

RCA TRANSMITTERS. Type ET. 4332B. 2 Mc to 20 Mc. 350 W. c.w. 250 w. 'phone. Two 813's output. Separate speech amplifier. Two 805 modulators. Rectifier—four 866's.

HALLICRAFTERS. BC610 with speech amplifiers, aerial tuning units, tuning boxes and coils.

HIGH SPEED TELEGRAPH equipment. "Boehme" (U.S.A.) Up to 400 words per minute on line or wireless. New. Working demonstration on request.

AR.88.D's. 5/-, 28/-. HRO's with 5 or 9 coils, power packs.

METAL RECTIFIERS type 78. Max. D.C. output at 36 v. 56 amp. Supply voltage 200/250 v. Brand new.

All above items in excellent working conditions with new valves. Large stock of transmitting condensers, valves, crystals and other components. Alignment and repair of communication receivers and all other amateur equipment.

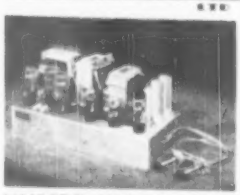
P.C.A. RADIO

THE ARCHES CAMBRIDGE GROVE, LONDON W.6. 'Phone RIV. 3279

Branch, 170, Goldhawk Road, W.12

CJR

ELECTRICAL & ELECTRONIC DEVELOPMENT



PRESENTING

THE FAMOUS WILLIAMSON AMPLIFIER

Precision built by experts to instrument-standards. Special models available for conversion of existing equipment (as illustrated), and for recording and cinema work.

Full particulars of this and other productions on application.

HUBERT STREET, ASTON, BIRMINGHAM, 6

Telephone: Aston Cross 2440

NOTICE

Owing to removal to our New Factory

SINCLAIR SPEAKER SERVICE

is

TEMPORARILY SUSPENDED

When we are again able to accept speakers for repair an announcement will be made in "Wireless World."

Electrical Sound & Television Patents Ltd.

2-3-4, Manor Way, Boreham Wood, Herts.

Phone Elstree 2138

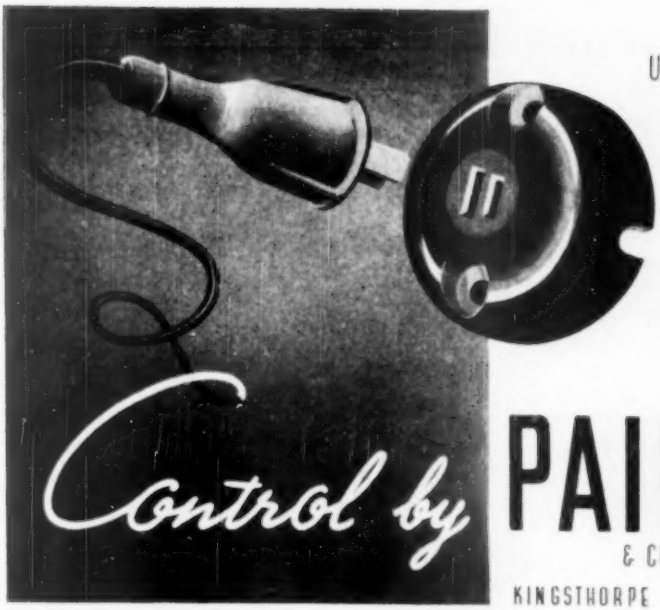
SAVAGE TRANSFORMERS DEVIZES LIMITED

INTRICATE TRANSFORMER CONSTRUCTION

SAVAGE TRANSFORMERS LIMITED

NURSTEED ROAD • DEVIZES • WILTS

TELEPHONE DEVIZES 515



UNBREAKABLE
RUBBER MOULDED
PLUG

MOULDED PLASTIC
SOCKET

BERYLLIUM
COPPER CONTACTS

Control by PAINTON
& COMPANY LTD
KINGSTHORPE • NORTHAMPTON

History in the making

Prehistoric man discovered that by extracting certain clays from the ground and roughly fashioning them into shapes before baking them in the sun, he could make serviceable vessels.

From this early beginning progress was made; and then a genius of the tribe discovered that by building up his roughpot on the flattened side of a boulder which had a pointed base he could, by spinning the boulder, manipulate his clay into various shapes—the beginning of the potter's wheel.

In modern times the products in porcelain made by the Taylor Tunnicliff organisation range from microscopic insulating units to giant porcelains for the highest voltage switchgear, transformers, transmission systems, etc.

Whatever your insulation problem may be Taylor Tunnicliff can help you, and their Research Department is at your service—including their Impulse Generator constructed for studying the behaviour of Insulators under steep-fronted transients up to 1,200,000 v. peak amplitude.

TAYLOR, TUNNICLIFF PORCELAIN

Keeps Electricity in its place.

TAYLOR, TUNNICLIFF & CO. LTD. *Head Office:* EASTWOOD, HANLEY, STAFFS. *Stoke-on-Trent 5272-4*
London: 125 HIGH HOLBORN, W.C.1. *Holborn 1951.* *Factories at:* Hanley, Stone, Longton, Staffs.

A Real MINOR

OSCILLOSCOPE

with a MAJOR

PERFORMANCE

Size: 8½" × 8½" × 12"
Weight: 13½ lbs.

Features:

- COMPACT
- ROBUST
- PORTABLE
- EASY TO USE
- IDEAL FOR THE SERVICEMAN

Price

£8-19-6

Carriage free U.K.

Specification:

Short Persistence 2½" screen. Green trace. Linear sawtooth generator with amplifier. Frequency range 5 c/s to 25 kc/s. Provision for internal or external synchronisation. Single stage Y amplifier. 200/250 volts 50 cycles supply. Black crackle stove enamel finish.

(Full details on request)

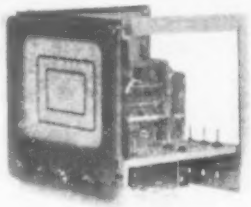
PROOPS BROS. LTD.

111 HIGH STREET, ESHER, SURREY

Telephone: Esher 3384

ANOTHER WINNER BY RUCO'S

A 6-POSITION VARIABLE SELECTIVITY 3-WAVE BAND FEEDER UNIT. R.F. STAGE. INFINITE IMPEDANCE DETECTION.



DON'T DELAY!

Write now for details

RUCO PRODUCTS

197 Lower Richmond Road

RICHMOND, SURREY

Phone: PRO 7463

GARLAND RADIO

MOTOR ALTERNATORS: Input 220v. D.C., Output 80v 2000 cps. 500w. New and unused. **£2** (plus 15/- carriage).
CELL TESTERS BY MUIRHEAD AND OTHERS: 0-3A D.C Meter, 5in. scale, and 0-80Ω Rheostat. Used Govt. surplus, **12/6**.
ROTARY TRANSFORMERS: Input 24v. D.C., Output 300v. D.C 60mA and 150v. D.C. 20mA. New and unused, **12/6**.
G.E.C. BLOWER MOTORS: 24v. D.C. or 30v A.C. New **10/6**. Used, **7/6**.
500KΩ WIRE-WOUND POTS: 10 watts, new and unused, **4/6**.
MAT RESISTORS: 350Ω, 250 watt, new **2/-** each, **21/-** per doz.
HUMDINGERS, 0-10Ω, new **6d.** each, **5/-** per doz.
.1 MFD. 4KV WKG., small block condensers, new, **3/-** each.
DIMMER SWITCHES, for lamps etc., new **9d.** each, **7/6** per doz.
IGRANIC PLUG AND JACK, new **2/9** complete.
POTENTIOMETERS: Wirewound: 5, 5, 100, 200, 250, 500, 600, 2K, 5K, 10K, 15K, 20K, 35K, 50KΩ; carbon, 500, 3K, 10K, 20K, 25K, 50K, 100K, 200K, 250K, 500K, 1M, 2M, 3MΩ; all unused govt. surplus, **1/9** each. Trade supplied. **S130 Voltage Stabilisers, 5/- each.**

Please include postage. Trade enquiries invited.

CHESHAM HOUSE, DEPTFORD BROADWAY, S.E.8

Phones: TIDewar 4412/3

VENTEX CABINETS

Scientifically designed. Beautifully finished. Your 12" loudspeaker fitted in a VENTEX CABINET will give you that superb depth of reproduction unobtainable with ordinary cabinets and baffles. Available in choice of veneers.

For STD. 12" **£15 10** inc. packing. Carr. extra.

Also supplied fitted any of GOODMAN'S 12" loudspeakers. Send for leaflet W.50

C. T. CHAPMAN (Reproducers) Ltd. FLAxman 3217

RILEY WORKS, RILEY STREET, CHELSEA, S.W.10

Consultants in all branches of Acoustic Engineering

GUARANTEED SPOTLESS SURPLUS BARGAINS

★ **P.M. SPEAKERS.** New and Boxed. 3½in., **12/9**; 5in., **10/-**; 6½in., **12/6**; 8in., **12/6**; 10in., **16/6**; 12in., **35/-**.

★ **OUTPUT TRANSFORMERS.** Standard Pentode, 7,000 ohms, **3/6**. Heavy Duty Multi-Ratio, 2/16 ohms, **12/6**. Push-Pull, twin secondary, **5/6**.

★ **TRANSMITTING VALVE**, 807, **6/3**.

★ **MOBILE AMPLIFIER** comprising Speaker, Microphone, Transformers, etc. An excellent Hailer system, requiring only a 12-volt battery to operate. Ideal for Election, Fete, Advertising, etc. **59/6**, carr. paid.

★★ **RADIO UNLIMITED, ELM RD., LONDON, E.17**

Tel.: KEY 4813

TELEBOOSTERS

for long range Television reception. Super high gain single-stage pre-amplifier. 2 stage, 1 VR91 valve, slug tuned. London or Birmingham. Co-axial plugs and sockets, flying leads for High and Low tension, fully screened, low noise. Price **£2 12 6**. Power units for above **£3 10 0**.

S.A.E. for trade test reports.

BOSCOMBE RADIO & ELECTRIC,

595, Christchurch Road, Boscombe, Bournemouth. Phone: 36522

YOU SHOULD HAVE A NEW TAYLOR

We can supply the latest Taylor Test-Equipment, and take your used Equipment in part exchange. Balance by cash or hire purchase.

Write, phone or send your gear along for inspection and offer.

UNIVERSITY RADIO LTD.

22 LISLE ST. Tel. GERRARD 8147 & 8582

Wireless World Classified Advertisements

Rate 6/- for 2 lines or less and 3/- for every additional line or part thereof, average lines 6 words. Box Numbers 2 words plus 1/-. Trade discount details available on application. Press Day: April 1950 issue, first Post Monday, March 6th. No responsibility accepted for errors.

WARNING

Readers are warned that Government surplus components which may be offered for sale through our columns carry no manufacturers' guarantee. Many of these components will have been designed for special purposes making them unsuitable for civilian use, or may have deteriorated as a result of the conditions under which they have been stored. We cannot undertake to deal with any complaints regarding any such components purchased.

NEW RECEIVERS AND AMPLIFIERS

MASON'S Vivenhoe, nr. Colchester.

ILLUSTRATED catalogue, price 9d. full details of Denco and Eddystone range, tuning units, television kits and Bernards radio books.

UNIVERSAL ELECTRONIC PRODUCTS, 36, Marylebone High St., London, W.1. Tel. Welbeck 4058.

SPECIALISTS in the design and manufacture of high fidelity reproducing equipment from 4-100 watts for domestic or industrial purposes. Our U.E.5 (6 watts) and U.E.7 (12watts) series amplifiers are designed especially for the connoisseur who requires the finest possible reproduction from recorded music; both amplifiers have a linear response over 30-20,000 cycles with a damping factor of 12, and incorporate pre-amplifier stage, together with independent control of bass and treble. Our policy is to produce an instrument which represents the highest standards in workmanship and performance and no expense has been spared to achieve this object. A new addition to our range is the type U.E.3 (4watts) at £11/10. We also supply a range of tuning units, both t.r.f. and superhet, for use in conjunction with either our own or other makes of amplifiers. We should be pleased to quote you for the design and construction of a unit or replacement chassis to your exact requirements. Full details of our products will be forwarded on request, and we would welcome the opportunity to demonstrate our equipment at any time to suit your convenience. [5552

THE full range of Armstrong radio and television chassis advertised in this issue is now available from the Midland distributors; write for details, open all day Saturdays.—Hayes Co., 1, Alcester Rd., Moseley, Birmingham, 13. [4873

DC mains? This new 8watt all miniature valve amplifier has been designed to give you high fidelity reproduction from DC mains supply, matched for moving coil pickup, output 2.5-15 ohms, bass and treble controls, complete £21/10, or with mic. stage, £24.

FELICITY GRAMOPHONE Co., 87a, Upper Richmond Rd., S.W.15. Putney 1665. [0041

BUY direct from the manufacturers. Our 5-valve all-wave superhet radiogram chassis is now available. The price suits the pocket too, only £12 complete with valves and 8in P.M. speaker. Give yourselves a treat. Fit our A/C55 in place of that old chassis and make a new radiogram of it. S.a.e. for illustrated leaflets. Trade enquiries invited.—Bayly Bros., 46, Pavilion Drive, Leigh-on-Sea, Essex. [4595

CONNOISSEUR'S receiver, acclaimed by its users as the finest receiver for the enthusiast and the only one with the following facilities: 9-1,500-metre, world-wide results on highly sensitive 10-valve receiver, comparable with any good communication set, or by change of switch, maximum fidelity reception of local stations on non-superhet receiver with high quality 2-PX4 push-pull amplifier incorporating all refinements, bass and treble tone control (boost to cut), whistle filter and gram input, etc.; basis rebuilt R1155, write for details or call for demonstration. FEEDER units as above, for use with external high-quality amplifiers; R1155 specialists, receivers repaired and re-aligned, also modified as above, or to your requirements; R1155 circuit and values 2/- post free.—R.T.S., Ltd., 5, Gladstone Rd., Wimbledon, S.W.19. Tel. Lib. 3303.

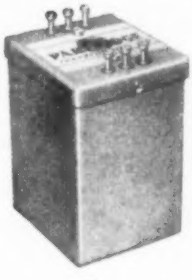
TELRAD ELECTRONICS, 70, Church Rd., Upper Norwood, London, S.E.19, designers and manufacturers of Telrad quality amplifiers for commercial and domestic use; unique amplifiers, with exceptional quality; built to satisfy the discriminating ear, bass and treble independent controls, providing widest possible variation to suit all recordings and varying acoustic properties of one room with another; £18, complete; full details on request.—Write, call or 'phone Livingstone 4879. [0019

WE do not make the Rolls-Royce car, but we do make the "Rolls-Royce" in amplifiers; the R.T.M.C. "Williamson" is now the password to perfection in quality reproduction; the undoubted merits of this product are now so well-known to readers of "W.W." that we need not amplify its many good points any further; write for our latest brochure and full details of tuners, etc.; latest type T.R.F. tuners from £10/10 built to specification; be sure you buy the R.T.M.C. version of this famous amplifier whereby you get quality of components and performance; 7-valve model, £25/10; 9-valve model with built-in pre-amplifier, £30/10.—Write or telephone, R.T.M.C. (Ealing), Ltd., Laurel House, 141 Little Ealing Lane, W.5. Ealing 6962. [5673

Partridge News

Now-hermetically sealed

IN OIL!



Illustrated is a typical Partridge Transformer (Type DN) in its Mumetal Screening Box. It is merely to remind you that all Partridge Precision Components (standard or "to specification" types) are now available as hermetically sealed units.

★

Then there's the 'PPO' range, designed to meet more fully the particular demands of push-pull output transformers where wide A.F. range with low distortion are vital.

FULL DATA ON REQUEST

PARTRIDGE

TRANSFORMERS LTD

ROEBUCK ROAD, KINGSTON-BY-PASS
TOLWORTH SURREY
Telephone: ELMbridge 6737-8

AMPLIFIERS, new, 60 watt heavy duty P.A. models, built for continuous rating and rack mounting, £40; lists.—Broadcast & Acoustic Equipment Co., Ltd., Tombland, Norwich.

ABBEY radiograms, choice of 46 different models from 31 to 192gns; auto-changers from 3½gns; brochures free, from—M. J. F. Edwards, 12, Coledale Drive, Stanmore, Middx.

TRUETONE amplifiers designed by fanatics for fanatics of high fidelity reproduction! Ranges 5-50w; £5 upwards; for demonstrations, write or phone—A. S. Colman, 1, St. Stephens Gdns., W.2. Bay. 3661 (after 7 p.m.) [5002

12 watt high-quality amplifiers, precision built instrument, bass and treble boost, high gain, complete with power pack, £12/10, less power pack, £8/15; send for descriptive literature and approval terms.—Broadcast & Acoustic Equipment Co., Ltd., Tombland, Norwich. [0067

MIDCO radio, new product! R/E1 radio feeder, high quality superhet feeder infinite impedance detector, tuning eye slide rule dial with flywheel drive; covers L., M. and S. waves, auto fidelity control of IF selectivity wide bandwidth on locals narrow high gain on distant stations, bass and treble tone control in high gain pre amp stage, switched for gram or radio, complete with 6 valves, £10; P/E1 amplifier power pack may be used with the RE/1 feeder, 8-10 watts high fidelity push-pull output, heavy duty power pack; 2 NFB loops, £13/10; price for PE/1 and RE/1, £23, carr. paid, delivery 10-14 days; also AA/5 5 watt amp., £5/10; AA/5T with bass and treble tone control, £5/17/6; AA/10 10 watt push-pull twin inputs, £10; PA/12T superb portable amplifier for dance halls etc. 12/15 watts, bass/treble controls, twin input mixers, £14; any type of audio amplifier quoted for; further details, catalogue, trade terms gratis.—Midland Radio Coil Products, 19, Newcomen Rd., Wellingborough.

RECEIVERS, AMPLIFIERS—SURPLUS AND SECONDHAND

AR88D commns. rcr., v. gd. cond., avibe. nr. Sidcup, offers over £35.—Box 2068. [5006

R1155 communications rec. (mod.), power pack and output, £10/10.—Box 2065.

A.R.88D, perfect, £60; A.R.88LF, £42/10.—"Tentmasters," King Alfreds Place, Birmingham, 1. [4859

EDDYSTONE S.640 32-1.7mc/s, in carton with 688 speaker, total use 20 hours, £25; Buckhurst 2068.—Box 2009. [4910

BUSH EB84, as new, hardly used, band spread tuning, 5 wavebands, perfect condition and reproduction, £25 or near.—Box 2062.

EDDYSTONE S.640 receivers, used 10 hours for special purpose, as new, £25; (matched speaker £2/10, if required).—Rothwell, Wards End, Adlington, Ches. [4920

£8, RAF 1155, perfect, in original transit case; £11 converted with output valve and smoothed mains power pack.—Jakubskind, 69, Church Rd., Moseley, Birmingham. [4771

ECHOPHONE de luxe communications receiver, 7 valves, 545kcs-31mcs, 110 to 240 volts a.c./d.c., fitted loudspeaker, perfect condition, price £22; telephone Byr 0426, or write—Pulley, 1, Woodlands, London Rd., Harrow-on-the-Hill, Middlesex. [4932

P.A. amplifiers, 8-watt, 10-watt, 30-watt, 60-watt (Marconi, etc.), microphones; G.E.C., Grampian, Trix and Phillips metal horn loudspeakers—over 200 to clear from £6/10 each, converters, etc.; send for list of P.A. bargains to Wycombe Electrical Supplies, Ltd., 51/52, Oxford St., High Wycombe, Bucks. Tel. H.W. 457.

R.F. units, 24 and 24 mod., 27 at 8/6, post 1/3, 25 at 12/6, 27 at 22/6; receiver type 1225 with 5×EF50, 2×VR53 and Vr54, £1 ea.; wavemeter G60, 180-230m/cs, complete with 10m/s crystal less valves, £4; ditto Marconi, Ekco CL/T No. 3, 50-90m/cs, a.c. mains with valves and microampmeter, £6/10; selector switches, 12w 6b 4/6, 9w 1b 1/6; S.T.C. metal recs., 230v 1½a, HW, new, 21/- ea., 4 for £3/10, 4 in bridge give 175v 5a from 230v direct; 10 assorted medium and short wave coils, mainly with dust cores and trimmers, 6/-; 100 assorted res. and cons. mainly on tag boards, 8/6; 100 assorted tubulars, mainly 1,000v, 10/-; hand generators for high or low vts., 12/6 ea.; No. 19 power units tested OK, 17/6; rotaries only 12v 500w 50ma, 175v 110ma, 12/6; liquid compasses for ariel setting, electrically illuminated with prismatic sighting, 35/-; Cossor DB scope, £20; H.R.O. Senior, £12/10; power units type 392, £3; LR phones, 3/6; balanced arm, 5/-; MC, 8/6; MC with mike, 10/6; R1124 receivers with 6 new 13v universal valves, 12/6, plus 2/6 carr.; Goodmans 4in speakers with grill, 12/6; Rola 6in, 12/6; if you are interested in optical equipment our new booklet "How to Use ex-Gov. Lens and Prisms," price 2/6 ea., will interest you.

H. ENGLISH, Rayleigh Rd., Hutton, Brentwood, Essex. [4868

NEW LOUDSPEAKERS

STILL the best for the barker, the Tridem 12D corner cabinet, supplied with or without speaker unit.

FELICITY GRAMOPHONE CO., 87a, Upper Richmond Rd., S.W.15. [0040

LATEST type WB concentric duplex speakers, see p. 74, Feb. "W.W." for full details: £6/6, complete with OPT.; Wharfedale de luxe cloth suspension types, with new super magnets, Super 8/CS, £4; Golden 10/CS, £4/10; W10/CS, £7/5, 3 or 15 ohms; W/12CS, £7/10; W15/CS, £12, 15 ohms only; Goodman Axiom 12, twin cone, £8/8; all post free from stock and fully guaranteed.

FRITH RADIOCRAFT, Ltd., Leicester. [0082

DOES "HIGH-FIDELITY" MEAN ANYTHING?

Recently we have been approached by several manufacturers of "high-fidelity" equipment who are looking for better speakers. It is generally supposed that the speaker is the only stumbling block in designing equipment for natural reproduction.

Past experience makes us doubtful of the outcome of this, not because we don't want to sell speakers but because we don't want the Hartley-Turner speaker to be thought responsible for distortion it cannot create.

In some cases where we thought the final sound was frightful the makers of the equipment thought it was much better than they ever had before and were still very much interested in the 215. What are we to do? There is no easy answer to that question.

But it does raise the point that "High-fidelity" is a term which is applied to equipment without there being any agreed basis of performance. It cannot therefore be a term of absolute merit.

There is no wishful thinking with us. We have produced a speaker which the world is coming to realise has a charm all its own, and the price is 7 per cent higher than in pre-war days. Properly driven, it is said by those who use it to approach very closely to the real thing.

"New Notes in Radio," 2/6 post free, gives you an honest story of what real high-fidelity means and involves. The Hartley-Turner 215 speaker at £9 will bring realisation. Descriptive literature free on request.

H. A. HARTLEY CO. LTD
152, HAMMERSMITH ROAD
LONDON, W.6. *RIVerside 7387*

A useful new handbook

The Principles of Television Reception

By A. W. Keen, M.I.E.E., A.M. Brit. I.R.E.

This is a systematic treatment, including a stage-by-stage examination of the receiver, and a review of the problem of natural-colour television. Fully illustrated. 30/- net.

Pitman

Parker Street, Kingsway, London, W.C.2

LOUDSPEAKERS, SURPLUS AND SECONDHAND

HARTLEY TURNER model 215, in new condition, £6/11.—Box 2961. (4977
WHARFEDALE W12 C.S. £9/10.—Briggs, Wilson, H.D. £8.—Box 2967. (5002
ROLA G.12 units Fs. PX4 & O.T., as new, £3.—Robb, Wirksworth, Nottingham. (4998
TWO Tannoy 12in speakers, as new, 35/- each.—Hope, Sin, Harogate Rd., Harrogate. (4996
HARTLEY-TURNER standard, 1250 ohm field, perfect condition, £4.—85, Oakwood Ave., Purley. (4992
VOIGT twin unit and reef, equip. £12.—Gent, 4 Ann's Arcade 14, Ann makers (action).—Hale, Southend, Hornsea. (4984
HARTLEY-TURNER 215, shop soiled, otherwise as new, £6/10.—E. F. Good, 1 RODE, Malvern. (5000
VOIGT loud speaker with H.C.C. H and energising unit £20.—Clarendon Radio, 112, Newcastle Rd., N.1.—Terminus 7481. (5009
HARTLEY Turner 215 in 24 mahogany baffle £20; two No. 14 E.M.I. pick-ups with transformers, 50/- each.—Pratt, Eaton, Topsham, Devon. (4788
SPEAKER raises large public address, with slight alteration, suitable for bass reflex type for Goodman's speaker, etc., sound construction, bargain at 35/-.—Box 2963. (4
ROCKWOOD & Co., 67, Lowlands Rd., Harrow, Middx. (4968
LOUDSPEAKERS in stock for immediate delivery; brand new by famous makers at knockout prices. PM 5in. 10/-; 6½in with trans. 15/-, 8in. 16/6, 10in. 22/-; mains energised 1250 ohm Field 8in. 15/-, 10in with trans. 22/-. (add 3d post).—Roding Labs., 93, Lord Avenue, Ilford. (4755

NEW DYNAMOS, MOTORS, ETC.

BATTERY chargers, 2-6-12volts, 1-amp. enclosed steel case with ammeter, a.c. mains operated, £4/7.—Thames Valley Products (W), 25, Camden Ave., Feltham. (4264
BATTERY chargers, 4 models 2-6-12v. 1-2-4 amp D.C.; any mains voltage; also large type special transformers, chokes, test gear, instrument car leaders, etc.—The Banner Electric Co., Ltd., Hoddesdon, Herts. (2212
JANETTE d.c. to a.c. rotary converters, 200-250 volts d.c. input, 200-250 volts, 50 cycles 1-phase, a.c. output at 500 watts, new, £20, 500 watts, £25, complete with smoothing for television and radio.—Johnson, 515, Kensington Rd., London, S.E.11. Reliance 1412-5.
ALL types of rotating electrical machinery up to 20kva available, including rotary converters, rotary transformers, motors, petrol and diesel-engined generating plants, alternators and d.c. generators. We are also in a position to quote for power transformers; as actual manufacturers we will be glad to quote for any quantity for home or export.
REVOLVING armature alternators, with separate exciter generators, 4-pole, ball bearing, 1,500 rpm, output 250v. 50 cycles, 1.25kva, excitation at 24-30v. price £29; ditto, 2-pole, ball bearing, 3,000rpm with 4kva output, £29.
ROTARY transformers, input 20v d.c., output 6.5v d.c. and 350v d.c. permanent magnet field 120v. ditto, input 20v d.c. and 1,200v. 70ma d.c. output, energised field, 35/-; ditto, input 12v d.c. output 500v 80ma d.c., energised field 35/-.
PETROL electric generator plants comprising a J.A.P. No. 2a single-cyl engine coupled to see-saw drive to an alternator giving an output of 230v. 50 cycles 1kva with screened low tension and filtered mains generator, eminently suitable for operating television and radio on farms, etc., price £40, such plants can be supplied with various outputs a.c. or d.c. for other applications.
CHAS. F. WARD, Lordscroft Works, Haverhill, Suffolk. Tel. 3.
(4183

DYNAMOS, MOTORS, ETC. SURPLUS AND SECONDHAND

ROTARY converter 250v d.c. input 230v a.c. 1 phase output 250v. fully supp. reasonable. Offer to 51, Church Rd., Smethwick. (4
FIRE engines, to petrol engines. "Wilmot" 5in "J" 4-stroke, air-cooled by fan, side valve, 750cc, complete petrol tank 10, gall., and fitted exhaust box, handle to start, impulse coupling and 1mm.p.g. detachable head, alu. piston, main shaft, big-end, inspection plate, fitted Governor 2,000rpm, guaranteed new and unused, external parts, chrome, stove enamelled £12/10 and 10/- carr. Eng. and Wagon Works.
DODDLAS Twin 540cc. ohv, air-cooled, fan, petrol tank, exhaust, oil pressure gauge, B.T.H. mag., twin V pulley, provision for mounting generator, new, unused, perfect, £20 and carr.
J.A.P. No. 2a engine, 1.2hp complete, petrol tank, etc., instruction book, new and unused, this engine is not ex-Govt. or surplus, £14 del.
T.V.S. 125cc 4-stroke, complete petrol tank, T.V.S. 125cc generators, 200 watt, with or without control box, cut-out, etc., 6v 85amp hr. lucas batteries, in crates, new, £7/10 del. free.
24-30v 1,200 watt charging boards, field circuit, 4 charge rates, 2 ammeters, 2 ammeters, line voltmeter, switches, fuse boxes, 5 carrs., 2 cut-outs, steel case stated, new, unused, £11/10 del.
CONAN 12-15v 600 watt petrol lighting plants self-starter, list £ new, unused, £25/10 del.
Zenith resistances var. 20 16a, 30 16a, new £1/10.
SELENIUM rectifier units, 200-250v, in various 100v out, lamp, steel case, 30/-, 2/6 carr.
Selenium rectifier charger, 1-40 cells, 5-amps output by 3 heavy switches, ammeter and choke, new and unused, £2 and carr., see displayed adv. page 95 for R.T.C. rectifiers.
PEARCE, 95, Hi Petol St., London, W.C.1.

a RECORD instrument

THE "MAJOR" INSULATION TESTER

Compact and light in weight, this latest addition to the Record family has a Constant Pressure generator of patent design. Ranges up to 500 volts 50 megohms with or without Continuity range of 0-30 ohms are available. Send for leaflet D.6.

THE RECORD ELECTRICAL CO. LTD.
BROADHEATH, ALTRINCHAM, CHESHIRE
Phone: Altrincham 2021. Grams: "Infusion" Altrincham. London Office: 26 Victoria St., S.W.1. 'Phone: Abbey 5119

"You can rely on us"

FOR CLEAN COMPONENTS AT COMPETITIVE PRICES
IMMEDIATE DISPATCH

MIDGET SUPERHET COIL PACKS
MW/LW Size 2½in. long, 1¼in. deep, 1¾in. high, Type "B" 25/-
MW/SW Size 2½in. long, 1¼in. deep, 1¾in. high, Type "A" 25/-
SW/MW/LW Size 3in. long, 1¼in. deep, 1¾in. high, Type "C" 28/6
Comprising, iron-cored midget coils, waverchange switch, ceramic trimmers, neatly assembled for easy tuning. The difficult part of a superhet overcome.

SPEAKER TRANSFORMERS
Super midget for "Personals" to match DL92, 384, etc. 4/3
Pentode output type 32/1 at bargain price for quality 4/6
Midget mains output transformer 3/9

LOUDSPEAKERS
Celestion 3½in., 25/6; 5½in., 10/6; 5in. with dust cover 9/9; 6½in., 12/6; with transformer, 17/6; 8in., 16/6; with transformer, 19/6; 10in., 21/-; 12in., 39/6; special lightweight 5in. small magnet 10/6.

COILS
Wanted "B" Coils. 3/- each, full range stocked. Blueprint with data supplied.
T.R.F. Matched pair, first quality, pair 7/6
MW iron-cored with trimmer 3/6

FILAMENT TRANSFORMERS
Primary 200/240 v. Secondary 5.3 v. 1.5a. Black crackle, small dimensions 8/6
Secondary 4 v. 3 a. 12/6

RESISTORS
½ watt, 3d.; 1 watt, 4d.; 1½ watt, 8d. Large stock.

BARGAIN OFFER
Chose 70 mfd 100 ohms, super quality. Boxed 5/-

VIEWMASTER TELEVISION
1 pocket to point circuits and booklet. Post free 5/6
Components stocked.

HOST OF OTHER LINES
Write, 'phone, or call for Price and Data folder containing Bargain List, 7½d. Stamp.

RADIO SERVICING Co.
444, Wandsworth Road, London, S.W.8
Phone: MACaulay 4152.
Off 77A, Bus 29, Train Wandsworth Rd. S.R. Station. Open till 6.30 p.m.

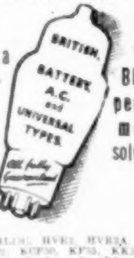
—J. BULL & SONS—

AMERICAN (BVA) TYPES.—0Z4, 1A3GT, 1A7G, 1H5G, 1LA4, 1LD5, 1LH4, 1LN5, 1N5G, 1R5, 1S4, 1S5, 1T4, 2A3, 2A4, 2D6, 3S4, 3V4, 5U4G, 5V4G, 5X4G, 5Y3G, 5Y3GT, 5Y4G, 5Z3, 5Z4, 5Z4G, 6A8, 6A7, 6AB4, 6AB7, 6AC7, 6AG5, 6AL5, 6AM5, 6AM6, 6AT6, 6B7, 6B8G, 6BA6, 6BE6, 6C4, 6C5, 6C6, 6C8G, 6D6, 6F6, 6F6G, 6F7, 6F8G, 6G5G, 6H6, 6H6GT, 6J5, 6J5G, 6J5GT, 6J7, 6J7G, 6J7GT, 6K6GT, 6K7, 6K7G, 6K7GT, 6K8, 6K8G, 6K8GT, 6L6G, 6L7, 6Q7G, 6Q7GT, 6R7, 6SA7, 6SG7, 6SF5, 6SG7, 6SH7, 6SJ7, 6SK7, 6SL7GT, 6SN7GT, 6SQ7, 6SR7, 6U5G, 6U7G, 6V6, 6V6G, 6V6GT, 6X5G, 6X5GT, 6Z4/12Z5, 6Y6G, 7B6, 7B7, 7C5, 7C6, 7H7, 7K7, 7Q7, 7R7, 7S7, 7Y4, 12A6, 12AT6, 12BA6, 12BE6, 12H6, 12J5GT, 12J7GT, 12K7GT, 12K8GT, 12Q7GT, 12SA7, 12SC7, 12SG7, 12SH7, 12SK7, 12SL7, 12SQ7, 12SR7, 14A7/12B7, 14B7, 14R7, 14S7, 19, 25A6G, 25L6GT, 25Z4G, 25Z6GT, 35A5, 35L6GT, 35Z4, 35Z4GT, 39/44, 41, 42, 43, 50L6GT, 75, 76, 77, 78, 80, 84, 807.

BRIMAR.—1D5, 1D6, 4D1, 7D3, 7D5, 7D6, 7D8, 8A1, (5 & 7), 8D2, 8D3, 9A1, 9D2, 9D6, 10D1, 11D3, 11D5, 15A2, 15D1, 15D2, D15, R2, R3, R10, R17, 8B2, 8B3.

COSSOR.—DDL4, DDT, GDT4B, MP/Pen, MS/Pen, MS/PenB, MVS/Pen, MVS/PenB, OM4, OM6, OM10, PT41, SL3A, SD6, SU2150, 2P, 4THA, 4TPB, 4TSA, 4TSP, 13SPA, 13VPA, 40SUA, 41MHL, 41MP, 41MPG, 41MPT, 41MTL, 41MTS, 41MXP, 41STH, 42MPT, 42OT, 42STDD, 42SPT, 42SU, 45SU, 22KU, 33KU, 34KU, 61BT, 61SPT, 63ME, 63SPT, 142BT, 184BT, 202DDT, 202STH, 202VP, 202VPB, 202THA, 210DDT, 210HF, 210LF, 210PG, 210SPT, 210VPA, 210VPT, 215P, 215SG, 220OT, 220PA, 220PT, 220TH, 240QP, 302THA, 332Pen, 402PenA, 405BU.

MULLARD.—AC042, AC044, AZ1, AZ31, AZ50, CL, CIC, CBL1, CBL31, CCH35, CL4, CL33, CY1, CY1C, CY31, DA3, DAC32, DAF91, DF33, DF91, DF70, DF91, DK32, DK91, DL35, DL36, DL71, DL72, DL92, DL93, DL94, DO30, DW2, DW4/350, DW4/500, EA50, EAC91, EAF41, EB34, EB41, EB91, EBC3, EBC33, EBC41, EBL1, EBL21, EBL31, EC31, EC50, EC52, EC53, EC54, EC91, ECC31, ECC33, ECC34, ECC35, ECC40, EC90, ECH3, ECH21, ECH35, ECH42, EF36, EF9, EF22, EF36, EF37, EF37A, EF39, EF40, EF41, EF42, EF50, EF54, EF55, EF91, EF92, EK2, EK32, EL3, EL5, EL31, EL32, EL33, EL35, EL37, EL38, EL41, EL42, EL50, EL91, EM1, EM4, EM34, EN31, EY51, EY91, EZ40, EZ41, FC2, FC2A, FC4, FC13, FC13C, FW4/500, FW4/800,



If yours is a problem— are the who will likely

valve BULLS people most solve it

GZ32, HL13, HL13C, HVR2, HVR2A, IW4/350, IW4/500, KBC32, KCF30, KF35, KK32, KL35, KLL32, Pen4A, PenB4, Pen4DD, Pen4VA, Pen36C, Pen428, PL33, PL38, PL38M, PM2A, PM2B, PM2HL, PM12M, PM22A, PM22D, PM24A, PM24M, PM202, PY31, PZ30, QP22B, SP2, SP4 (5 & 7), SP4B, SP13, SP13C, TDD2A, TDD4, TDD13C, TH4B, TH2C, TH30C, TSE4, UAF41, UAF42, UB41, UBC41, UBL21, UCH21, UCH42, UF41, UF42, UM34, UR1C, UR3C, UY21, UY41, VP2, VP2B, VP4 (5/7), VP4A (5/7), VP4B, VP13A, VP13C, 2D4A, 354V, [illegible], 1,8D2.

MAZDA.—AC/HL, AC/HLDD, AC/P, AC/P4, AC/Pen (5 & 7), AC/S2/VM, AC/TH1, AC/TP, AC2/HL, AC2/Pen, AC2/PEN/DD, AC4/Pen, AC5/Pen, AC5/PEN/DD, AC/VP1 (5 & 7), AC/VP2, D1, DD41, DD207, DD620, DL/616, HL21DD, HL23, HL23DD, HL41, HL41DD, HL42DD, HL133DD, ME41, ME91, P41, P61, PA20, Pen25, Pen44, Pen45, Pen45DD, Pen46, Pen220A, Pen383, Pen453DD, PenDD4020, PP3250, QP25, QP230, SP41, SP42, SP61, SP181, T41, TH41, TH233, TH2321, TP25, TP23, TP26, TP2620, U21, U22, U24, U201, U403, U404, U801, U4020, U10, U16, U17, U18, U19, V914, VP23, VP41, VP133, VP210, VP1322, 1C1, 1F3, 1FD9, 1P10, 1P11, 6C9, 6D1, 6D2, 6F11, 6F12, 6F13, 6F14, 6F15, 6K25, 6L18, 6LD20, 6P25, 6P26, 6P28, 10C1, 10F1, 10F3, 10F9, 10LD11, 10P13, 10P14, 20D1, 20F2, 20P1.

MARCONI OSRAM.—B30, B65, D41M, D42, D43, D63M, D77, DH63, DH63M, DH76, DH77, DH81, DH101, DH147, DL63, DL74M, DL82, DL145, DN41, DN143, GT1C, GU50, H30, H63, HD14, HD24, HL2M, KT2, KT32, KT33C, KT36, KT41, KT44, KT45, KT61, KT63, KT66, KT71, KT74, KT76, KT81, KT101, KTW61, KYW63, KTZ41, KTZ63, L63, L77, LP2, MH4, MH41, MHD4, MHL4, MKT4 (5 & 7), ML4, MSP4 (5 & 7), MSP41, MS4B, MX40, MU14, N14, N17, N77, N142, N148, N147, P2, PX4, PX25, QP21, S130, U10, U14, U16, U17, U18/20, U31, U33, U35, U37, U50, U52, U70, U74, U76, U81, U82, U84, U101, U142, U143, U145, U147, VMP4G, VMS4, VMS4B, W17, W21 (4 & 7), W42, W61M, W76, W77, W81M, W101, W143, W145, W147, W148, WD142, X14, X17, X22, X41, X41C, X41M, X61M, X63, X65, X76M, X81M, X101, X142, X143, X145, X147, X148, Y61, Y62, Y63, Z14, Z21, Z62, Z63/617, Z66, Z77, Z90, ZD17, 161, 361, 302, 304.

All at B.O.T. prices.

RADIO BULLS VALVES

246 HIGH ST. HARLESDEN, N.W.10

ROTARY converter, ex-Admiralty, input 110v d.c., output 230v, 87a, 50c a.c., practically new; £9 or offers.—Hayes, Trawsfynydd, Merioneth. [4994

97 6. charging switchboards, 12v-32v, 300 and 1,260 watts, volts, amps, cut-outs, fuses, resistances, etc., 4 take-offs, superb unit, in case, or send £5 carriage paid; 75/- dynamos, 24 volts, 1,000 watts, 9in×7in, 5/8in spindle, or send 80/- carriage paid; 75/-, 230v 1/50 1/4hp electric motors, incorporating 1,260 cycle converter, or send 80/- carriage paid; 56/- mains transformer switchboards, 230v a.c. to 12v, 5 separate take-offs, complete distribution panel, all switches, fuses, amps, etc., brand new, or send 60/- carriage paid; 55/-, electric motors, 12v and 24 v, 1/4hp, 4in×4in, with 5/8in spindle for drive, beautiful job, or send 60/- carriage paid; 45/-, dynamotor units, containing 12v, 24v, 130v and 500v d.c. dynamos or suitable as 6v, 12v or 24v motor, approx. 1/4hp, 11in×5in, with spindle to take small grindstone, mop, etc., also contain adjustable 24v cut-out automatic voltage control, smoothing condenser, resistances and many other extremely useful fittings, beautifully made, or send 50/- carriage paid; 36/-, radio wavemeters, adjustment dial 350-370 Mc/s, beautiful instrument in case, or send 40/- carriage paid; best other valuable equipment; lists free.—Powerco (late Bennington Power Supplies), Wandsworth Town Station, York Rd., London, S.W.18. Bat. 5254.

NEW TEST EQUIPMENT

CONVERSION unit for use with 1ma d.c. meter, a.c., current ranges 10, 100 and 1,000ma, £2/7/6, particulars and list of test gear in kit form.—L. A. MacLachlan & Co., 16, Thistle St., Stirling. [4923

17 range a.c./d.c. multimeter, small size, movement 200μa m.c., ranges a.c./d.c. volts 10, 50, 100, 500, 1,000v at 4,500Ω per volt, d.c. current 1, 10, 100, 500ma; resistance 0-5kΩ, 0-500kΩ, 0-5meg, all self-contained, fully guaranteed; £5/10, complete with leads and test prods; send for illustrated leaflet.
C. & W. ELECTRONICS, 15, Oswald Rd., Oswestry, Salop. [4775

AUDIO oscillator 10 c/s-80 kc/s, spot frequencies 10 c/s intervals to 1 kc/s, 100 c/s intervals to 10 kc/s, 1 kc/s intervals above, 1% accuracy, [illegible], giving 0-40 volts, mains input 200-250v, 50 c/s, new, surplus to requirements; £12/10; also other specialised testgear.—Earl Services, Matford Ave., Exeter. [4890

OSCILLOSCOPE and Wobbulator complete, £20; T.B. c/s 10 to 350,000 c/s X and Y plate amplifiers, easy to handle, has outstanding performance, fully guaranteed, immediate delivery with set of leads and booklet, "Oscilloscope Technique"; further details from the manufacturers.—Erskine Laboratories, Ltd., Scalby, Scarborough. [5456

CALLING Sutton Coldfield and the television world; television signal generator model 100, range 40-80 mcs, sound and double-pattern modulation, large directly calibrated scale, designed attenuator, a.c. operated, 100-250 volts, first-class instrument, £9/19/6; stamp for details please.—Electronic Equipment Co., West Malling, Kent. [4906

HIGH-GRADE resistance meters, incorporating 8in scale Weston microammeter, 6 ranges covering 1/10-ohm to 10 megohms, accuracy better than 1%, mains operated, ideal for factory production or service use; immediate delivery; further details from the manufacturers.—Aeronautical Electronic & Engineering Co., Sunleigh Works, Alperton, Middx. Tel. Wembley 2755.

TEST EQUIPMENT SURPLUS AND SECONDHAND

AVO valve tester, as new, £9/10; Avo bridge, perf., £6.—Box 2059. [4987

TAYLOR 65H sig.-gen., 100kc/s, 45mc/s, £10, as new.—Heavens, 89, Shakespeare Cres., E.12. [4948

0-100 microammeter, blank scale, plug-in, 2 1/2in bakelite, 15/9.—A. Stansfield, 253, Park Lane, Keighley. [4961

OSCILLOGRAPHS Cossor double beam model 3339, reconditioned, from £25.—Cox Radio, West St., Bognor Regis. [4895

ESPEY sig. gen., model 1-122-B, range 15-125mc, 400-625c/s A.F. mod., as brand new in oak case, £14.—Box 2058. [4986

FOR sale.—In brand new condition, Marconi signal generator, type TF867, Cossor FM signal generator, Avo signal generator (high range 50kc-90mc), also other laboratory equipment, Sullivan decade boxes, etc., please send for details.—Box 2017. [4925

FERRIS 18 D s.g. gen. (5-210Mc), also 78E (190-250Mc) and G.R. 720A heterodyne freq. meter (10-3,000Mc); enquiries invited, see also this column Feb. issue; stamp for components lists.—R. T. & I. Service, 254, Grove Green Rd., London, E.11. Ley. 4986. [0056

TRANSMITTING EQUIPMENT

TR9 transmitter-receivers, these were formerly sold at £6 each, the remaining few to be cleared at 25/-, carriage paid.
THE STAMFORD RADIO Co., 199, Stamford St., Ashton-under-Lyne, Lancs. [4796

MANY items of transmitting gear for disposal, new and unused, including kit for B4/40, 1d stamp details.—Smith, 7, Lorne Road, Walthamstow, E.17. [0070

NEW GRAMOPHONE AND SOUND EQUIPMENT

WEARITE tape recording decks, £21; M.S.S. recording machines, blank discs, etc.; processing your own masters, 32/6 per side; microphones, magnetic tape, amplifiers, etc.; full trade terms; immediate delivery.—Sound Discs (Supplies), Ltd., 178, Bispham Rd., Southport, Lancs. [4601

It Pays to Purchase

ELECTRADIX BARGAINS

LABORATORY GEAR. Sullivan Marine Galvo suspended Moving Coil, on solid base with adjusting feet, in lacquered brass case, **£10.** Sullivan Testing Keys, Reversing, **£4.** Weston Moving Coil Relay 380 ohms resistance 50 micro amps, **£3/10/-.** Sullivan Moving coil Relay, **£3.** G.P.O. Polarised Relays in brass case with glass top, plat. contacts, **25/-.** G.P.O. Sounders, **25/-.** Pitkin Lab. Resistances 50 ohms 2 amps, mounted in polished wood base with glass front and heavy ebonite control knob, **40/-;** few with damaged glass **25/-.** Avo-All Wave Oscillator 95 Kc to 40 megacycles in 6 ranges, brand new, **£20** each. Bridge Megger 500 volts 40 megs. with decade Resistance box in wood cases, **£25.** 250 volts 20 megs., **£20.**

RESISTANCES. Variable wire wound lab. type laminated brush gear 1.2 ohms 15 amp., **7/6;** 6 ohm 6 amp., **15/-;** 300 ohm, 1/2 amp., **15/-;** 290 ohm .45 amp., **15/-;** Isenthal Geared Resistances, 60 ohm, 2.8 amp., **25/-.**

TRANSFORMERS. Foster 50 ohm, 2 amp, double wound, **15/-.** B.T.H. 200/230/250 volts to 75 volts 6 amp. and 2 volts 20 amp., **45/-.** Auto Booster Transformers 900 watt size 200/250 volts in 10-volt steps, useful in power cuts, **£5.** Auto Transformers 230/110 volts, 85 watt, **25/-.** 150 watt, **35/-.** 1 kW, **£7/10/-.** Ex-W.D. Transformers 220 volts, 50 cycles, input 53 volts, 15 amp., 0-30, 0-60 volts 1 amp. and 6 volts 5 amp., **£5.**

IRONCLAD SWITCHGEAR. We have a large stock of Ironclad Switches and Switchfuses by leading makers, write for special list "W."

DYNAMOS. For battery charging on boats, etc., for use ashore or afloat, 24 volt 30 amp. 4-pole 1,000/1,200 revs. shunt, fan cooled, **£20** each. 24 volt 18 amps., shunt fan cooled, **£17.** 24 volt 18 amp., 1,200 revs. vent. enclosed, **£12/10.** 12 volt 25 amp. 800/1,000 revs. fan cooled, **£15** with control box. Carriage extra on all Dynamos.

D.C. DYNAMOS. 12 volt 10 amp. C.A.V. 1,400 r.p.m., **£2.** 24 volt 100 amp. 4,000/6,000 revs., **£5/10/-.** 30 volt 5 amp. 1500 revs., **35/-,** carriage on any Dynamo, **5/-.**

A.C. MOTORS. Small sewing machine motors, 230 volts A.C., square construction, with pulley belt and bracket, **£4/10/-;** foot control, **55/-** extra.

LIGHTING PLANTS. A.C. Onan Plants, 2 1/2 kVA 110 volt 3.7h.p. 2 cy. 4-stroke air cooled 1,800 r.p.m. Generator 110 volt 21.7 amp., S.P. new Government surplus, **£60** each. 3kW 3-phase plant, 5 h.p. 1-cy. 2-stroke air cooled, Gen. 380 volt, **£50.**

D.C. LIGHTING PLANTS. Villiers 500 watt 2 h.p. engine direct coupled to 18 volt 30 amp. D.C. Gen. for battery charging, with Switchboard and fuel tank, **£22/10/-.** Pelapone 500-watt water cooled Plants, 1 h.p. engine direct coupled to 50/70 volt 10 amp. Dynamo, **£35.**

FREQUENCY METERS. 230 volt 6in. Ironclad 40/60 cycles, Switchboard type, **£4/10/-.**

TELEPHONES. Ex-G.P.O. wall-type set of Constructors parts for office or garage use, comprising Bracket Mike, Mag. Bell, Transformer and condenser, Switch-Hook and Receiver, connection strip in polished box 8in. x 6in. x 3 1/2in. Hand Mag. Generator and wiring diagram, **35/-,** carriage **5/-** extra.

A.C. MOTORS. 1/4 h.p. 230 volt 1,425 r.p.m., new, **£5/10/-.** 1/2 h.p. capacitator start 230 volt 50 cy. s.p. 1,425 r.p.m., **£8/10/-.**

D.C. MOTORS. 1/4 h.p., 110 volt A.E.G., **30/-.**

PUMPS. Rotary Suds Pumps 8ft. lift, 35ft. head, 60 g.p.h., with pulley, **£4/10/-.**

MOTOR PUMPS. Suds type 1/2 h.p. 200 or 400 volt 3-phase 50 cy., 1,425 r.p.m., 10ft. head, 600 g.p.h., **£8/10/-.**

MAGNETS. Swift Levick S.L.36 instrument type, circular horseshoe 1 3/4in. dia. 3/4in. thick, 3/4in. polar gap drilled poles, weight 2 ozs., lift 3 lb., **2/6** each, or **12/6** for six. The Alni disc magnet, the wonder midget magnet, 3/4in. dia., 3/8in. thick, 3/16in. hole in pot with keeper, **3/6.** D.C. Electro Magnets, weight 10 oz., lift on 2 volt 1 1/2 lb., 4 volt 3 lb., 6 volt 4 lb., **5/-.** Permanent flat bar magnets, 2 1/4in. x 1in. x 1/4in., drilled two holes each end, **2/-** pair. Large stock of Horseshoe Magnets. Send for special leaflet, "W.W."

COMPASSES. Binnacle Boat Compasses. Liquid Model, in housing with glass windows, **40/-.**

PARCELS. 10 lb. useful oddments for the junk box. All clean, dismantled from Government and other surplus apparatus, **7/6** post free. (For home buyers only).

Please include postage for mail orders.

ELECTRADIX RADIOS

214 Queenstown Road, London, S.W.8

Telephone: MACaulay 2159

GOVT SURPLUS, UNUSED

CONDENSERS

of all types . . .

We can offer, FOR IMMEDIATE DELIVERY from very generous stocks, a wide range of ultra-high quality fixed paper Condensers, from .001 μF to 8 μF. Also STOCKS of small, genuine MICA Condensers from .00001 (10 pf) to .01 μF (10,000 pf). *Prices are exceedingly moderate.*

Enquiries are invited for manufacturers' requirements, wholesale and export only for bulk quantities, and for scheduled deliveries over a period as required.

Most condensers are now available for immediate delivery.

Please request our 4 page bulletin CONSEVEN 01114

CLAUDE LYONS LTD.

180 Tottenham Court Rd., London, W.1

and 76, Oldhall St., Liverpool 3, Lancs.

DUKE & CO.,

219 ILFORD LANE, ILFORD · ESSEX.

REQUESTED BARGAINS THIS MONTH

The **7/6 BARGAIN** sets packed with useful components and gear. A limited quantity only left, post 2/-. **PRE-H.F. UNITS**, for T.V. or V.H.F. receivers, requires only EF50. Co-axial plug in and out, still a few, **2/6**, plus 6d. post. **CONDENSERS**, a few new 32 + 32 350 v. **3/6**; 8 + 8, **3/-**; 16 + 16, **3/6**; 8 + 16, 450 v., **2/6**; 16 mfd. 350 v. D.C., **3/-**; 16 mfd., 450 v. D.C., **3/3**; 8 mfd. 500 v. D.C., **2/6**. **TRANSFORMERS**, new by request, 2K + 2-0-2, **25/9**, plus 2/- post. We always stock E.H.T. 2K, **19/6**, as list. **CHOKES**, 120 mA., **9/6**; midget 60-40 mA., 4 for **5/-**. **T.V. Aerial** chimney mast fixing brackets, **5/-**, plus 1/6 post. **VALVES**, at B.O.T. prices, no clients disappointed, our advice and assistance available to all. **CRYSTAL SETS** at **8/6** still going out to repeat orders. We guarantee reception. **TUNING CONDENSERS**, **2/2** single, **4/6** two gang, **2/6** three gang. **METERS**, out of stock, but write for lists and what you require. **INDUCTION MOTORS**, 200/250 v. A.C., complete with long spindle. Clients say they make ideal rim drives for gram motors, milk shakers etc., **17/6**, post 1/-. **PHONES**, low **2/6**, High 4K, **4/6**. **SPEAKERS**, new extensions in cabinet, perm. 3 ohms, **14/6**, plus 2/- post. Speakers, 5in. **10/-**, 6in. **11/3**, 8in. **11/9**, 10in. **19/6**, 12in. **35/-**; Truvox Elliptical, **19/6**. **T.R.F. KITS**, 3 valve 2 **wave** band. Wonderful results with our new practical circuit. In walnut bakelite cabinet, **£4/19/6**. Ivory cabinet, **6/-** extra.

When remitting C.W.O. please allow sufficient for postage. Send STAMPS ONLY for detailed lists. TRADE and EXPORT enquiries invited. Order now in confidence of our money back guarantee.

MAGNETIC ¼in TAPE recording heads standard model record-playback with split winding for bias and 5 or 15Ω audio, 50/- each; erasing heads, 50/- each. HI-FIDELITY ¼in tape heads, circular Mu-metal laminations stacked ¼in, fully screened single unit (record-play), £4/10, twin unit with tape lifting (record-play and erase), £9, full assembly (record, play, erase) with tape lifting, £14, impedance 5 or 15Ω to order, bias winding for 75T osc. sec. coil; ¼in Emitape 5,000ft, £4/10; osc. coils, 15/-, circuits supplied free. Trade enquiries invited.—Morecambe Sound Service, 4-6, Green St., Morecambe. Tel. 1161. [0075]

INFINITE baffle corner deflectors, scientifically designed acoustic chambers for 8 to 15in speakers; lists.—Broadcast & Acoustic Equipment Co., Ltd., Tombland, Norwich. [0064]

TRANSFORMERS, tone control and loud speaker filter chokes for all "W.W." circuits; special designs promptly made.—R. Clarke, 30, Langland Crescent, S. Stanmore, Middx. Wor. 5321. [5976]

MOTORS, B&R shaded pole type, for recorders, etc., R1 32/-, R2 25/-; B&R gram motors, rim drive, diecast turntable, £3/4/3; Collaro AC47, centre drive, variable speed, 12in turntable, £5/18/2; gram units, Collaro AC504 motor and magnetic PU, £5/3/2, or with crystal PU, £5/17/6; Garrard "E" motor and magnetic PU, £5/10/6; Garrard RC70A autochanger, non-mixer, £18/7/7; Marconi AC100, lightweight PU, non-mixer, £19/0/6; all prices include PT; all sent post free.
FRITH RADIOCRAFT, Ltd., Leicester. [0027]

GRAMOPHONE AND SOUND EQUIPMENT SURPLUS AND SECONDHAND

BRIERLY HI-FI pick-up, unused, with transformer, excess to contract, £7.—Box 2059. [4957

DECCA pick-up C, new Sapphire, with motor and non-ferrous turntable, £7/10.—New-court. [4947

WILKINS & Wright coil pickup, with transformer, as new, £4/10.—Driver, Whittingham Lane, Goosnargh, Preston. [5004

C.D.P. recording motor and tracking gear less cutting head, £10.—G.5.BML, 4, Queen Mary's Ave., Basingstoke. Tel. 479. [4965

MAGNETIC sound recording wire, stainless steel, temporary wooden spools, approx. 1½ hours running time at 2ft per sec., 14/- per reel.—A. Smart, 40, Grange Rd., Halesowen.

RECORDING equipment in good condition for sale, 2 m.s.e., RD/45 recorders, mobile carrying case, 7-channel mixer, rotary converter, rotary generator, and accessories, £100 or near offer.—Miss Dale, Flat 645, Nell Gwyn House, Sloan Avenue, S.W.3. Kensington 9455. [4958

RADIOGRAM chassis, 5 valve, 3 waveband replacement unit, large attractive glass dial, coloured and station named, 5 watts output, complete with P.M. speaker, £12/10 inc. tax, carriage paid; single and autochange gram units by leading makers, available for immediate delivery.—Radio Unlimited, Elm Road, London, E.17. Key 4813. [0063

NEW COMPONENTS

WIRELESS World televisors.

FOR approved components all enquiries should be addressed to the makers: "Handyparts," 226-228, Merton Rd., Wimbledon, S.W.19. Lib. 7461. S.a.e. for replies. [0033

TRANSFORMERS to exact specification.

LINE O/P trans. for W.W. televisor, 45/-; O/P trans., for Williamson amplifier, 75/-; mains trans. for Williamson pre-amp and radio feeder unit, 50ma O/P, 29/6; television filament trans., 6.3v 3amp and 2, 4, 6.3v 2amp, 29/6; tag panels fitted as specified; trans. for amplifiers, televisors, valve testers, test gear, chargers, etc., to any published specification, or to your own design.
E.P.D. TRANSFORMER PRODUCTS, 51, Queenstown Rd., Battersea, S.W.8. Tel. Mac. 4150. [4579

THE simplest s'het pack, type M1, M.L. waves, 22/6, thousands in use.
DOUGLAS COIL Co., Brinklow, Nr. Rugby.

BRAND new telephone handsets, carbon mike, 4-way cord and plug, latest streamline type, 10/6 each, post 9d, or 2 for £1 post free, fully guaranteed.
FRITH RADIOCRAFT, Ltd., Leicester. [0026

WILLESDEN high quality transformers available ex-stock for the D.T.N. Williamson Amplifier, Electronic Eng. Televisor and all well-known circuits.
WILLESDEN TRANSFORMER Co., Ltd., 781, Harrow Rd., N.W.10. Tel. No. Ladbroke 2846.

THE brain of any good radio is an Osmor Q coilpack, used with our matched components you can build a radio really worth boasting about; write to-day for free circuits and our latest lists including the Bargain Bulletin.
OSMOR RADIO PRODUCTS, Ltd., Bridge View Works, Borough Hill, Croydon. (Cro. 1220.)

TELEBOOSTERS for long range television reception, super high gain single-stage pre-amplifier, 2-stage, 1 VR91 valve, slug tuned London or Birmingham, coaxial plugs and sockets fixing leads for high and low tension, fully screened, low noise, price £2/12/6; power units for above, £3/10; s.a.e. for trade test report.
BOSCOMBE RADIO & ELECTRIC, 595, Christchurch Rd., Boscombe, Bournemouth. Tel. 36502.

TELRAD ELECTRONICS, 70, Church Rd., Upper Norwood, London, S.E.19, television components for "View Master," Belling & Lee, Bulgin, Colvern, Morganite, Plessey, T.C.C., Wearite, Westinghouse, Whiteley; complete parts as specified in stock; also E.E. chassis, mains transformers, etc. Write, call or phone your order: Livingstone 4770. [5025

AMC TELEVISION

Manufactured to "*Electronic Engineering*" Televisor Specification.

MIDLAND T.V. Sound and Vision Panels fitted with formers and dust cores now available.

LINE OUTPUT TRANSFORMERS

NEW Improved SET OF GANTRIES COMPLETE

FOCUS COILS

LINE AND FRAME SCANNING COIL ASSEMBLIES

All Steel **CADMIUM PLATED POWER AND TIME BASE CHASSIS** valve-holders, 3 point and single socket and all necessary cut-outs.

SOUND PANEL CHASSIS ASSEMBLY, fitted with screens, valve-holders, formers and dust cores.

VISION PANEL CHASSIS ASSEMBLY, fitted with screens, valve-holders, formers and dust cores.

9" C.R. TUBE SUPPORT to mounting on top of Gantry Assembly.

9" CREAM MASKS.

5, SHAKESPEARE RD., FINCHLEY, N.3

'Phone: FINchley 2188

THE CANDLER SYSTEM will train you for your MORSE CODE TEST

Read the following extracts from unsolicited letters sent us by Candler students:—

Ref. No. 3739. (First five lessons.) "I recently passed the G.P.O. Amateurs' Morse Examination after your first five lessons." (*Junior Course.*)

Ref. No. 2541. (Glad to announce.) "I am glad to announce that I recently passed the P.M.G. Special Exam., and as you will see on my report, my speeds are now far ahead of the speeds needed in the examination. I therefore walked through the telegraphy part." (*Junior Course.*)

Ref. [illegible]. (A really wonderful course.) "I feel it my duty to express my appreciation for a really wonderful course. Before taking the course my 'solid' receiving speed was about 18 to 19 w.p.m.—this I copied letter by letter—and was I nervous. Today I can copy 25 to 28 w.p.m. at one word behind. I can read 20 to 25 w.p.m. as easily as reading a book. Frankly I think that all the 'goods' I have gained from the Candler System cannot be represented by—so many words per minute, but rather as a lifetime's experience gained in a few weeks. It has been said 'you have to pay to learn'—true, but with Candler you pay so little and learn so much." (*Advanced Course.*)

There are Candler Courses for the absolute *Beginner* and for *Operators* desiring to increase their accuracy and speed in the Receiving and Sending of the Morse Code.

Full details of Candler Courses are given in the

"BOOK OF FACTS"

Sent post free on request.

Courses on Cash or Monthly Payment terms.

THE CANDLER SYSTEM CO.

(55w) 121 Kingsway, London, W.C.2

Candler System Co., Denver, Colorado, U.S.A.

ALLWAVE a.c. kits 3 valves including rectifier panel and chassis ready drilled supplied with medium wave coil, carriage paid £5/10, extra coils 4/6 each.
RADIO-AID Ltd. Retail Section, 29 Market St. Watford, Herts. [0039

"WIRELESS WORLD" televisor, deflector coil assembly 22/-; focus coil, 25/-; block, osc trans 9/-; superhet coils London or Birmingham, £2/12/6; chassis kits, £6; rectifier, H4/200, 28/- each.—R. F. Shilton, 19, Clarendon Rd., Salisbury, Wilts. [4860

54/9 only for the famous Model 30 tuning unit, consisting of 3-waveband Model 30 superhet coil pack, pair I.F. transformers, 2-gang condenser and attractive dial (8in×6in), each component individually selected pre-aligned, sealed and the whole matched together as a unit; the superhet you build with this unit needs no further adjustment! Or supplied instead with the superb J.B. horizontal 5pin wheel tuner and dial assembly at 75/6. Full details of these and our other high quality products (coils, IFTs, mains transformers, etc.), together with many circuits and constructional tips, contained in the "Home Constructor Handbook," price 1/-. Mail order office.
SUPACOILS, 98, Greenway Ave., London, E.17.

TELEVISION, Bel P.M. focus rings, universal application, for all 9-12in tubes, triode or tetrode, self-supporting, spring grip to neck, micrometer adjustment, chrome finish, best Ticonal steel ensures high flux density, drift is eliminated and power saved; an ideal replacement component for the trade, universal 55/-, Tetrode only 52/6.
"WIRELESS WORLD" Televisor, complete set of 20 coils and corrector chokes, superhet Lond. or Bir., 52/6; set of two R.F. chassis and 11 screening boxes, drilled for our modified IF transformers, copper, 42/6; complete set, including 2 timebase, 1 V/F box, 12in power pack chassis, sundry angles, 98/- (please note reduced price); deflector coils, exactly to spec., 35/-; line O/P trans., £2; block osc transformers, 15/-; focus coils, 37/6; mains trans., £3.
ELECTRONIC Eng. televisor, set of 14 coils, 8 heater and 1 video choke, 18/6, less chokes 16/6.
PRACTICAL wireless televisor, set of 8 TRF coils and 1 video choke, 16/6, chassis, fully drilled, £4; S. A. Knight's superset version, and other televisor or B'cast coils made to order, enquiries for lists and from the trade invited.
BEL SOUND PRODUCTS Co., Marlborough Yard, Archway, London, N.19. Tel. North 1025.

COMPONENTS—SURPLUS AND SECONDHAND

TELEKIT SUPPLY Co.
SLC5 Monitor units, utilising 2½in tube (VCR-139), 3 valves and scanning components, also metal cabinet, 11in×6½in×8½in, with hinged viewing hood; this unit makes ideal oscilloscope, 30/-; as above, but less valves and tube, 6/-; new oscilloscope cabinets in black crackle, 11in×6½×8½, with hinged viewing hood, 10/-; moving coil mike inserts, 3/-; supports and bases for VCR139, 2/- each; new BA5 earpieces (two of these make perfect house telephone), only length of twin wire needed, 4/6 pair; new R.A.F. morse sets, complete with key, twin coil buzzer, 4½v, baseboard, batt. clip and instructions, 5/-; new lightweight headphones, 60Ω, 5/6 pair, c.w.o.
TELEKIT SUPPLY Co., 51, Addington Rd., West Wickham, Kent. [5013

SOUTHERN RADIO'S wireless bargains.
RECEIVERS, type R.1125, complete in metal case, new and cartoned, complete 2 valves and all components, 15/-.
PACKARD-BELL Pre-amplifier, complete with 2 valves and all components in sealed cartons with instruction sheet, 22/6; moving coil headsets with microphone and headphones, 7/6.
ELECTROVOICE microphones, carbon type, DM-1, 5/6; Lucas inspection lamps, with lead and plug, 2/6; Tannoy carbon microphone inserts, 2/6; throat microphones, complete with lead and plug, 3/6; sleeving 1mm, gross yards coils, minimum quantity, 6/-; sectional aerials, 3ft, interlocking, 3/9, base for same 2/6; crystal detectors, semi-permanent type, 2/6; crystals and catswhisker only 9d; tubular condensers, 0.1 mfd, 4/6 per dozen; full publication list 2½d; please see our display advertisement in this issue of "Wireless World" on p. 85.
SOUTHERN RADIO SUPPLY, Ltd., 46, Lisle St., London, W.C. Gerrard 6653. [0016

FRAME aerials, M.L. chassis mounting, 9½in ×5½in, 7/6; manufacturers' surplus midget L.F. chokes, 2/6.
HILLFIELDS MAIL RADIO, 8, Burnham Rd., Whitley, Coventry. [0022

1/16 hp motors, 230v, a.c., 50cps, squirrel cage, totally enclosed, ball bearings, precision made by G.E.C., brand new; 15/6.
K. LOGAN, Westalley, Hitchin, Herts. [4885

METAL rectifiers, H.T., 280 volts, 4/9; send stamp for complete lists.—Hendreys, Ltd., 17, Westgate, Chichester, Sussex. [4977

LITTLEWOODS, North London's best selection of radio and television components; pay us a visit or post or phone your enquiries; no lists.
LITTLEWOOD & GRUNER, Ltd., 27, Ballards Lane, Finchley, N.3. Fin. 5060. [0055

TV pre-amp 2-valve self-contained for London, by Clive Courtenay, £5, antiference H aerial complete, 45/-.—1890, Stratford Rd., Birmingham 28. [4961

CONSTANT voltage transformers, 1.5kva, by Foster, input 180-260v, 1ph, 50cps, output 230v, plus minus 1%, 7 amps, oil filled, unused; £18 each, f.o.r.—P. B. Crawshay, 166, Pixmore Way, Letchworth, Herts. [4969

You're SURE to get it at
STERN'S
ESTABLISHED 25 YEARS

Resistances. A parcel containing 100 popular assorted values for ¼ watt type, 6/-, or ½ watt, 8/9.

Moving Coil Speakers. Well-known manufacturer's surplus, all 2/3 ohms and P.M. 10in. 23/6, 8in. 17/- (15 ohms 18/9), 6½in. 16/6, 5in. 10/-, 3½in. 15/-, Rola 8in. 16/6, 12in. Truvox 47/6. Goodmans £6/15/-.

Potentiometers. New Centralab. 2K, 5K, 10K, 25K, 50K, 100K, ¼, ½, 1 and 2 meg., less switch, 3/9, with switch 6/-. Midget Type 2/6. Midget with switch, ¼, ½ and 1 meg., 6/-.

Coils. Denco Maxi "Q," High "Q" with miniature size Litz wound on Polystyrene Formers with adjustable Iron Dust Cores. Aerial, H.F., or Oscillator for 465 k/c or 1.6 m/c. Range covers all wavebands from 5.8 to 2,000 metres. Wiring diagram. **Prices:** Chassis Mounting, 3/9 (with Reset, 4/9); Octal fitting pin base 4/- (with Reset, 5/-).

Denco T.R.F. Matched pair Medium and Long Waves, 6/6 pair. Weymouth T.R.F. Matched pair M. and L. Waves 9/6 pair. Superhet Matched pair S.M. and L. Waves, 8/9 or 11/6 pair. All types Wearite "P" Coils, 3/- each in stock. Weymouth Midget [illegible] Iron Core, Aerial H.F. or Osc., 3/6 each.

Electrolytic Condensers. B.E.C. Midget Can Tubular, 8 mfd. 450 v. [illegible] dia.), 2/6; 8-8 mfd. 450 v. [illegible] dia.), 4/-; 16-8 mfd. 450 v. [illegible] dia.), 4/6; 32 mfd. 350 v. 2/6 (450 v., 5/-); 16-8 mfd. 450 v. [illegible] dia.), 5/-; Dubilier "Drilitic" Card Tubular 4 mfd. 500 v., 3/6; 8 mfd. 500 v., 4/-; 16 mfd. 500 v., 4/6; B.I. Can, standard size, 8 mfd. 500 v., 3/9; 8-8 mfd. 500 v., 5/-; 16 mfd. 500 v., 4/3; 16-16 mfd. 500 v., 5/3; 32 mfd. 500 v., 5/-. All New Stock.

Denco I.F. Liner for accurately lining-up 465 k/c. or 1.6 m/c. I.F. channels. Pre-tuned circuits, battery operated and completely self-contained. Price 39/6 (incl. bty.).

Osmor Midget Coil Pack. Size [illegible] covering S. M. and L. waves. Coils wound on Polystyrene Formers with adjustable Iron Cores, ensures efficient performance. Factory wired and aligned. Price, including full circuits for Superhet 465 k/c. Unit, 33/-. Also available for T.R.F. circuit covering M. and L. Waves, 30/-.

Output Transformer—Stern's. Midget [illegible], ratio 66-1, 4/6 (or ratio 90-1, 4/6). Elstone Multi-ratio (over 12 ratios, some C.T.), 2/6 watts 7/6. Stern's Heavy Duty Multi-ratio, all C/Tapped, handles 15 watts and suits P.X.4s, 6L6s, etc., 25/6. Lola Multi-ratio, 2/6 watts 10/6.

L.F. Chokes. Midget 10 henry 220 ohm 40 mA., 3/6; 20 hny. 250 ohm 60 mA., 5/6; 20 hny. 300 ohm 100 mA., 12/9; 7 hny. 50 ohm 250 mA., 18/6; 5 hny. 220 ohm 130 mA., 8/6; 20 hny. 120 ohm 250 mA., 22/6.

Inter-Valve Transformer. Midget [illegible], ratio 3-1 (also ratio 5-1) 4/6 each. Varley "Niclet" ratio 4-1, 10/-; Heavy Duty, P. Pull Driver 2-1 each half, 40 mA., 8/-.

Aluminium Chassis. Substantially made of gauge 16 S.W.G. with four sides. 7in.×4in.×2in., 3/3; 9in.×5in.×2½in., 4/-; 10in.×6in.×2½in., 4/11; 12in.×8in.×2½in., 5/6; 12in.×9in.×2½in., 6/8; 14in.×9in.×2½in., 6/11; 16in.×8in.×2½in., 7/3; 16in.×9in.×2½in., 8/6.

I.F. Transformer, 465 k.c. New well-known manufacturer's surplus [illegible] Iron Core, 9/- each, or, size [illegible], capacity tuned, 13/9 pair. Denco Iron Core, 465 k/c. or 1.6 m/c., [illegible], 16/6 pair. Wearite Stand Cap, Tuned, 465 k/c, 20/- pair.

Meter Rectifiers. Westinghouse 250 micro-amp., 11/6, 1 mA., 10/6, 5 mA., 4/9.

Selenium Rectifiers. H.T.L. Wave, 250 v. 50 mA., 5/-; 250 v. 100 mA., 5/9; 250 v. 100 mA., 7/6. Bridge Rectifier 6 v. 1½ amp., 11/3; 12 v. 1½ amp., 12/6; 12 v. 3 amp., 19/6; 12 v. 5 amp., 25/-; 24 v. 3 amp., 23/6. Also L.T. 3/12 volt at ½ amp. max., 3/6.

Charger Transformers. Each has input of 230 volts. Output (a) 24 volts tapped 15 v., 9 v. and 4 v. at 3 amps., 21/6; (b) 30 volts tapped 15 v. and 9 v. at 3 amps., 22/-; (c) 15 volts tapped 9 v. at 3 amps., 14/3; (d) 12 volts, 1½ amps., 11/3; (e) 15 volts tapped 9 v. at 5 amps., 19/9.

Valve Heater Auto Transformer. Step-up or down, 2 v., 4 v., 5 v., 6.3 v., at 2 amp., 9/6. 4 v. 2 amp to 6.3 v. 2 amp reversible 6/-, 4 v. 2 amp to 6.3 v. 2 amp reversible, 6/-.

Filament Transformer. Input 230 volts, outputs 6.3 v. 1½ amp., 7/6; 4 v. 1½ amp., 7/6; Input 200/250 v., output 4v. (C.T.) 1½ amp., 4 v. 3 amp., 6.3 v. 3 amp., 19/6. Inputs 230 v. outputs 6.3 v. 4 amp., 18/3; or 4 volt 5 amp., 16/9.

Denco Chassis Cutter. Adjustable between [illegible] and 2½in. dia., used with Hand Brace, 7/6.

● ● ● ●

WIRELESS AND AMPLIFIER ECONOMY KITS AND CIRCUITS

All kits and Circuits show a practical Component layout.

● ● ● ●

A Midget T.R.F. Battery Portable "Personal" Kit. A complete Kit of Parts to build a Midget 4-valve All-dry Battery Personal Set. Consists of Regenerative T.R.F. Circuit employing Flat Tuned Frame Aerial, with Denco Iron Dust Cored Coil, thereby ensuring maximum gain for Single-Tuned stage covering medium Waveband.

Valve Line-up: 1T4 (R.F. Ampl.), 1T4 (Detector), 1S5 (1st A.F.), and 3S4 (output). Includes latest Rola 3in. Moving Coil Speaker, and a Chassis already drilled and shaped. A consumption of only 7 mA. ensures long battery life. The Kit is designed for a cabinet, minimum size [illegible]. Detailed Building Instructions with Practical Layout and Circuit included with Kit make assembly easy.

Price for Complete Kit £3/18/9 (plus 16/7 P.T.). Suitable unpolished Cabinet 6¼×4½×3in., 12/9. Ever Ready Bill Battery, 9/7. Building Instructions, Circuit, etc., supplied separately, 1/6.

● ● ● ●

"Wireless World" Midget A.C. Mains 2-Valve Receiver. We can supply all the components including valves and M/Coil Speaker to build this set as specified in the March issue at a total cost of £3. Reprint of detailed assembly instructions and circuit supplied separately for 9d. A small complete outfit is now available to convert the 2-valve Receiver to the 3-valve Receiver covering Medium and Long waves, at a total cost of 33/6 including drilled chassis and complete assembly instructions. (Supplied separately for 9d.)

● ● ● ●

"Wireless World" Midget A.C. Mains 3-Valve Receiver covering Long and Medium Wavebands. We can supply all the components including drilled chassis, valves, moving coil speaker, etc., to build this set as specified in the February issue at a total cost of £4/5/0, including a reprint of the Assembly Instructions, showing component layout, and circuit (reprint supplied separately for 9d.).

We can supply all the Components, including Valves, M/Coil Speaker, etc., to build a Midget A.C./D.C. Mains T.R.F. 3-Valve (plus Metal Rectifier) Receiver as designed and specified by a popular Technical Magazine, at a total cost of £4/17/6. A reprint of the assembly instructions, and layout available for 9d.

● ● ● ●

An Entirely Complete 3-Valve Amplifier Kit of Parts. Operating on A.C. or D.C. Mains 200/250 volts. Has an output of over 3 watts, incorporating a 6in. M/Coil Speaker, Volume and Tone Controls. Price, including Wiring Diagram, 75/-, or without speaker, 65/-.

"ELECTRONIC" VALVE VOLTMETER. We can supply the COMPLETE KIT OF PARTS, including the Valve, Diode and Meter, etc., to build this instrument, as published in the January issue of "Electronic Engineering," complete with a reprint of the wiring diagram and assembly instructions (supplied separately for 9d.) at a total cost of £3/5/0.

TELEVISION!! The "Viewmaster" Televisor assembly instructions showing Wiring Diagram and Practical Component layout, now available for 5/-. We have the specified Components, including the T.C.C.—Bulgin—Morganite—W.B.—Westinghouse—Plessey—Colvern, etc., (all) in stock. Separate Components also available.

"Electronic" Televisor. Complete range of specified Components in Stock, instruction and explanatory booklet available for 2/6, London area, and at 4/6 for Midland area.

● Send 2d. stamp for our **New Comprehensive Stock List,** this now shows the various Kits we have available, and also the latest Television Kits, with the individual Component Prices. Please cover postage and packing when ordering.

STERN RADIO LTD., 109 and 115 FLEET STREET, E.C.4.

Telephone: Central 5814 and 2280

COMPONENTS MATERIALS AND ACCESSORIES AT A SAVING!

PROMPT DESPATCH

(subject to being unsold)

ALL GOODS GUARANTEED TO THEIR RATING.

R.F. CO-AXIAL CABLE. Single-core flexible conductor 14/.0076 Polythene Insulated, Tinned Copper Wire Braided and P.V.C. Outer Sheathed. Colours: Black, Brown. 2/- per yd.

CO-AXIAL FEED or CONTROL CABLE. Single Core Flexible Conductor 14/.0076 P.V.C. Insulated, Tinned Copper Wire Braided and P.V.C. Outer Sheathed. Colour: Brown. 9d. per yd.

COMPONENTS, ETC. G.L. Octal Valve Screens 8d. Vibrator Earthing Clips, 1/-. Plain Walnut Finish Bakelite Control Knobs, 1½in. Diam. 9d. High Density 8in. P.M. Speaker Units, 3.6 ohm Coil 15/6. 1 Meg. Volume Controls with Switch (Heavy Duty) 6/6. 6 volt and 12 volt Non-Synchronous 4-pin Vibrators 12/6. 6 volt Self Rectifying Vibrators, 15/3. Dial Lamp Holders 1/2. International Octal Chassis Valve Holders, 5d. Miniature 50 m/a Smoothing Chokes 3/9. 3 Tag Terminal Strips, 4d. 2 Tag ditto, 3d. 2 Pye H.F. Chokes, 3/3. 4-60 pf Mica Trimmers, 1/2. 40-90 pf Ditto, 1/5. Valve Top Clips, 2/- per doz. Tubes of Bostik Cement 2/2. Drum Drive Tension Springs 3d. 5,000 ohm Auto Distributor Suppressors 1/3. Bulgin 5,000 ohm Wire Wound Heavy Duty Resistances on Ceramic Formers, Max. Diss. 20 Watts, 3/6. Painton 25,000 ohm Wire Wound Resistors in Vitreous Enamel, Max. Diss. 10 Watts 4/-. Zenith 6.4 ohm Wire Wound Resistors in Vitreous Enamel, Max. Diss. 30 Watts, 6/3. South Type V. 24 volt Thermal Delay Switches 12/6. Belling-Lee Shrouded 10 pin Connector Plugs 4/-. Sockets for same, chassis mounting, 2/-. 4-pin Chassis Mounting Valve Holders, 7d. 5-pin Ditto, 9d. 1¼in. long, 25 Amp. Glass Cartridge Fuses, 4/- per doz. Dial lamps, 6.5 volt .15 Amp. M.E.S. 10 mm. 1/7.

SPECIAL QUOTATIONS FOR QUANTITIES

Dealers, Wholesalers and Manufacturers Supplied. For Further Lines of Cables, Capacitors, Resistors, etc. see our Advertisement in the Miscellaneous Columns. Terms: C.W.O. or C.O.D. Inland. Over £1 on Post Goods Only. Please include sufficient to cover carriage and packing, extra if under £5. Overseas Orders Carriage and Packing extra.

CAR & GENERAL RADIO

Altenbury Lane, Timperley, Cheshire.

Tel.: SAle (Manchester) 2214/5. Grams and Cables: "Motif," Altrincham.

PENNINE RADIO

AUDIO SIGNAL GENERATOR

- HIGH STABILITY
- WIDE RANGE 40-16000 C.P.S.
- LOW PRICE
- 3 WATTS OUTPUT

LIST PRICE **£9-9-0**

Write for Particulars

PENNINE AMPLIFIERS

SOUTHGATE, ELLAND, YORKS, ENG.

Tel.: Elland 2107

BRAND-NEW guaranteed goods.

MAINS transformers, fully interleaved and impregnated; primaries 200-230-250v 50 c.p.s. screened, drop through types 260-0-260v 60ma, 6.3v 3a, 5v 2a 13/11; 350-0-350v 80ma, 6.3v 3a, 5v 2a 16/9; midget type upright mounting, 250-0-250v 60ma, 6.3v 1.5a, 5v 2a, size 3-2½-3in, 17/9; fully shrouded upright mounting types, 350-0-350v 100ma, 6.3v-4v C.T. 3a, 5v-4v 2a 21/9; 350-0-350v 120ma, 6.3v 4a, 5v 3a 25/-; 350-0-350v 150ma, 6.3v 4a, 5v 3a 27/9; 250-0-250v, 6.3v 6a, 5v 3a for 1355 conversion 25/9; 425-0-425v 200ma, 6.3v-4v 4a C.T., 6.3v-4v 4a C.T., 5v-4v 3a 41/6; vibrator transformers, 6v input 300-0-300v 60ma output, 6/9; Rola 6½in mains energised speakers, 2-3 ohms (field 750 ohms), 9/6; Ceramic double trimmers 45 plus 45mmfd, 4/9 doz; co-axial plugs and sockets, 6/9 doz; electrolytics, metal tubular, 8mfd 275v, 12/- doz; Can 32mfd 350v, 1/9 ea; volume controls, standard length spindle, 0.5 meg, with switch, 3/3 ea, 34/- doz; fully punched 5-valve superhet chassis, cadmiumised steel, 14-6-2½in, 2/6 ea; full list of component bargains 2½d; special list trade, c.w.o. or c.o.d. over £1, postage extra under £5.

E. POWELL, 3, Rockingham St., Leeds, 2. Callers 15, Queen Square, Leeds, 2. [9445

SUPREME RADIO, 746B, Romford Rd., Manor Park, London, E.12. Tel. Ilf. 1260. Est. 15 years. 1950 bargains.

FLY-BACK type line trans. with provision for EY51 valve, 22/6 ea.; line and frame scanning coils, 25/6 ea.; P.M. focus units from 20/- ea.; H.T. trans., 350-0-350v 6.3v 6 amp, 4v 4 amp, 4v 3 amp, 0.2v 6.3v 2 amp, 250 m/a, with screen 70/- ea.; 5 hy 250 m/a choke, 15/9 ea.; 10hy 80 m/a choke, 6/3 ea.; all parts in stock for London or Birmingham E.E. televisor; ceramic E.F.50 valve holders, 6d ea., 5/6 doz.; retaining rings for same, 6d ea.; bakelite E.A.50 valve holders, 6d ea.; ½-watt resistors, 10Ω, 22Ω, 27Ω, 47Ω, 82Ω, 120Ω, 180Ω, 250Ω, 330Ω, 390Ω, 820Ω, 1KΩ, 3.9KΩ, 11KΩ, 470KΩ, and 10MΩ, 1/9 doz. or assorted doz, 18/6 gross only; ½-watt resistors, 2.2KΩ, 6.8KΩ, 16KΩ, 18KΩ, 33KΩ, 100KΩ, 150KΩ, 220KΩ, 2/- doz. or assorted doz, 21/- gross only; 1-watt resistances, 270Ω, 470Ω, 1KΩ, 3.3KΩ, 8.2KΩ, 18KΩ, 33KΩ, 56KΩ, 68KΩ, 1MΩ and 2MΩ, 4/- doz. or assorted, 45/- gross only; 2-watt resistances, 2KΩ, 18KΩ, 1MΩ, 5/6 doz only, or assorted; noise suppressor units, consisting of 2, 0.1mfd cond. and iron cored choke, 6d ea., 5/- doz; 3 meg. vol. controls, 7½d ea.; 1MΩ carbon and 5KΩ W.W. vol. controls, 1/- ea.; 4mfd 350v screw base metal can, small, 6d ea.; 4mfd 550v screw base cond., metal, 1/- ea., 11/- doz; 12mfd 50v screw base metal cond., 6d ea., 5/- doz only; 50mfd 50v, 50mfd 12v, 25mfd 25v and 10mfd 25v, metal tag end type, 1/- ea., 11/- doz, or assorted doz only; tubular wire end cond., 0.01mfd 1 k/v, 0.02mfd 750v, 0.05mfd 500v and 0.1mfd 350v, 6d ea., 5/6 doz only, or ass. doz only; Midget mica cond., 0.001mfd, 0.0005mfd, 0.0003 mfd, 6d ea., 5/6 doz only, or ass. Metalmite cond., 0.01mfd 350v, and 0.002mfd 500v, 9d ea., 8/- doz, or ass. can type cond., 8mfd 450v, 2/6 ea.; 16+32mfd 350v, 3/6 ea.; 16+8mfd 450v, 3/6 ea.; 32mfd 500v Drylitic cardboard outer case, wire ends cond., 5/- ea.; 16mfd 350v Drylitic metal case, small type cond., 1/9 ea.; fully shrouded main trans., 350-0-350v 80m/a, 4v 4amp and 4v 2amp, primary tapped for 200-250v, fully shrouded, 14/11 ea.; also 275-0-275v 80m/a 6.3v 3amp, 5v 2amp, primary tapped for 200-250v, half shrouded, 14/6 ea.; fixed mica cond., ppf type, 40 ppf, 50 ppf, 60 ppf, 65 ppf, 180 ppf, 305 ppf, 307 ppf, 500 ppf, 530 ppf, 570 ppf, 590 ppf, 700 ppf, 1,800 ppf, and 4,550 ppf, all at 2/6 doz only, or ass. 0.01mfd 3 k/v and 0.005mfd mica, tag end cond., 3/- doz; 0.1mfd 2.5 K/vw can type cond., 2/- ea.; just arrived, brand new stock 25mfd 25v and 50mfd 50v tubular cardboard wire end condensers, 15/- doz only or assorted dozen; many other bargain lines in stock; terms, c.w.o.; no c.o.d.; send 6d extra for postage orders under £5; 2½d s.a.e. all enquiries and list. [0021

VACUUM relays, thermal type 6v 30ma (approx.), will switch 230v 10amps, length 3½in, diam. 1in, fitted with standard 4-pin valve base, 6/6 ea.

VELODYNES, Magslip and Selsyns, many types in stock, send for list, technical advisory service available.

HOPTON RADIO, 1, Hopton Parade, Streatham High Rd., London, S.W.16. Streatham 6165.

OHMITE and Clarostat U.S.A. rheostat-potentiometers, the finest obtainable, example from the Ohmite range, 12 ohms, 2.04 amps, 7/3; send for list of Ohmite all porcelain, vitreous enamelled rheostats.

A. STANFIELD, 250, Park Lane, Keighley, Yorkshire. [4990

"YOU'LL probably get it at Smith's, Edgware Rd." Everything for the constructor, from a 1/10watt resistor to a radiogram cabinet. Lowest prices, biggest variety.—Near Metropolitan Music Hall. Pad. 5891. [8005

HIGH quality output transformers, Williamson type, £2/12/6; standard drilled and tapped racks for 19in panels, 5ft 6in angle iron, £1 each; 6ft 3in channel, new, £3/15; VT104 trans. valves, new, £1 each.—Broadcast & Acoustic Equipment Co., Ltd., Tombland, Norwich. [0069

MANUFACTURERS.—Enamel, copper wires, all gauges, laminations, all types, huge stocks radio components, s.m., m/m, p.t. and block condensers, close tolerance and high stability resistors to 1%; all goods guaranteed.—L. E. Simmonds, Ltd., 5a, Byron Rd., Harrow, Middx. Telephones: Harrow 2524 and 0315.

SEND for list of components to be cleared.—Finbow, B.C.M./Alfonics, London, W.C.1.

OPPORTUNITIES IN RADIO

Get this FREE Book!

"ENGINEERING OPPORTUNITIES" reveals how you can become technically-qualified at home for a highly-paid key-appointment in the vast Radio and Television Industry. In 176 pages of intensely interesting matter, it includes full details of our up-to-the-minute home study courses in all branches of **TELEVISION and RADIO, A.M. Brit. I.R.E., A.M.I.E.E., City & Guilds, Special Television, Servicing, Sound Film Projection, Short Wave, High Frequency, and General Wireless Courses.**

We definitely Guarantee

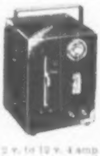
"NO PASS—NO FEE"

If you're earning less than £10 a week, this enlightening book is for you. Write for your copy today. It will be sent **FREE** and without obligation.

BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY

388b SHAKESPEARE HOUSE
17/19 STRATFORD PLACE, LONDON, W.1

BIET



CHARGERS, CHARGER KITS, RECTIFIERS,

All new goods. Full guarantee. Low prices.

2 v. to 12 v. 4 amp. max. slider type chargers as illus., heavy duty, weight 22 lb., selenium rectifier, impregnated transformer, 200/250 v. a.c., **£6/5/0**, crate 7/6, carr. 5s.

E.772, 12 v. 3 amp. constant output chargers, weight 12 lb. in Romeo green cases, **£4/4/0**. Ditto, E.775, 6 v. 3a/12 v. 2a., **£4/4/0**.

"AUTOMAT" 2 amp. motorist's charger for 6 v. and 12 v., weight 9 lb., **65/-**. Ditto Junior "**Automat**" for 6 v. 2 amp., 12 v. 1 amp., **53/-**.

FOOLPROOF CHARGER KITS. S.T.C. 12 v. 3 amp. rectifier, high grade 60-watt transformer, barretter, for 2 v., 6 v., 12 v. charger, no rheostat or ammeter needed, **46/6**, post 1/4. Ditto but 4 amp. rectifier and 75-watt trans., **55/-**. Ditto but 6 v. 4 amp./12 v. 2 amp., **48/6**. Handsome case and small parts, **17/6**.

2 v., 6 v., 12 v. 2 amp. kit, **36/6**, case, terminals, etc., 12/6 extra. Minor Kit with case for 6 v. 2 a./12 v. 1 a., **42/6**, post 1/3.

HEAVY DUTY KITS. S.T.C., 12 v. 8 amp. giant finned rectifier, 140-watt transformer, slider res., high-grade ammeter for 6 v., 12 v. charger, **£4 15 0**, post 2/6. Ditto, but 4 amp., **£3 15 0**. Weight 17 lb.

S.T.C. L.T. RECTIFIERS, new, 6 v. 0.5 amp., **4/10**. 6 v. 4 amp., **16/6**; 12/15 v. 1 amp., **9/-**; 2 amp., **11/-**; 3 amp., **18/6**; 4 amp., **22/-**; large finned type 12/15 v. 5 amp., **25/-**; 6 amp., **30/-**; 10 amp., **42/-**; 6 v. 12 amp., **25/-**; also 24 v. and 36 v. rects. up to 10 amp. bridge, s.t. and h.w., with trans. if required.

H.T. RECTIFIERS, small space selenium type, D.C. output 250 v. 100 mA. bridge type, **12/6**; 400 v. 100 mA. bridge, **24/-**; 250 v. 60 mA. h.w. for a.c./d.c. sets, **7/-**; 110 v. 60 mA., **6/-**; 300-0-300 v. 80 mA., **9/-**; Elim. rect., 115 v. 30 mA., **6/-**; or with 20-watt trans., tickle rect., 2-8 mfd. conds. and case for 120 v. 20 mA. eliminator, **42/-**, less case **35/-**, post 1/-.

AMMETERS, 0-6 amp. flush, bakelite, **12/6**; slider resistances 4 ohms 6 amps., **18/6**, post 1/3. Rola 8in. P.M.s, less trans., **12/6**.

CHAMPION PRODUCTS

43 Uplands Way, London, N.21

Phone: LAB 4457

TELEVISION, all parts in stock for all televisor. Haynes scan and focus coils, line trans. model on view.—H.O. Radio, 1550, Stratford Rd., Birmingham, 28. [4418

2 mfds. 1,000v. oil-filled condensers, new, surplus, 3/- each; Lustraphone m.c. mikes, brand new goods, sealed cartons, 52/-; M.B.3 instrument rectifiers, 3/6.—Champion, 43, Uplands Way, London, N.21. Tel. Lab. 4457.

2/- doz 20pf Ceramicons, 2/6 doz; .01mfd mica wire ends, 3/6 doz; .01mfd 1,000v, .1mfd 350v met. case, 4/- doz, .1mfd 500v, 50pf+50pf Ceramic trimmers 5d; all guaranteed; list from —T. G. Howell & Co., 29, McWilliam Rd., Brighton, 7. [5026

MODULATOR type 67.—Fitted standard mains 230 V.A.C. 50 cycle power pack, giving 345 V.D.C. 125MA.; 6.3 volts 5 amps; 6.3 volts, 25 amps; 12 valves, viz., 5 V.R.65; 2 V.R.54; 3 V.R.92; 1 V.R.116; 1 5Z4G and various useful components; £4 each, carriage 7/6 each.

CLOCK work timers, new surplus, suitable for process work, dark-room timing, etc., variable timing 1 to 60 seconds relay to operate off 6v battery capable of handling 100 watts supplied with each movement; price with relay, 56/- each, post paid; each movement is fully tested before dispatch.

CONDENSERS, Electrolytic, 1,000mfd, 25v dc W.K.G., 4/6 each; post paid; 45/- per doz.

RECTIFIER units, ac to dc, input 200-250v ac, 50 cycles, 1-phase, output 160-200v dc, ¼ amp, price 41/- each, post paid.

15-AMP MERCURY SWITCHES.—Fitted with saddle and clip 4/- each, postage paid.

S.T.C. WIRE-WOUND RESISTANCE BOBBIN —⅝in diam., ⅛in deep, 2½% accurate; values 25, 100, 200, 400 and 1,000 ohms; price 4/- per set, post paid; special quotation for larger quantities.

THERMOSTATS MADE BY UNITY.—Voltages up to 250-15/20 amps, temperature variable from 55-70 degrees fahrenheit; price 26/- each; trade supplied.

G.E.C. 20 MFD. CONDENSERS.—For power factor correction, with internal safety leak, rating 275 volts, 50 cycles; price 8/- each; special quotation for quantities.

EXTRACTOR MOTORS.—Complete with fan, 12V, 3½ amps, dc/16 volts, ac new in original packing; price 17/6, postage 1/6.

SOLENOIDS.—Operating voltage 12-24 volts, 2½in long, 1in diam.; ideal for model train track controls; 4/- each, post paid.

50-VOLT, 50-CYCLE, 3-PHASE MOTORS.—2,800 r.p.m., 1/10 hp; price £1 each, carriage 2/-.

SYNCHRONOUS clock units, self-starting, 200-250v ac, 50 cycle, fitted Sangamo motors, consumption 2½ watts, size 2¼in dia, 2in deep, geared 1 rev 60 min, friction reset; ideal movements for making electric clocks, time switches, etc., nickel plated finish, complete with 12 to 1 dial train and 5in hands, price 22/6, post paid; Sangamo as above, final speed, one rev. per min. less dial train, ideal for dark-room process time, etc., price 20/- each, post paid.

SANGAMO motors with gear train, final speed 1 rev 12 mins. approx. 16/- each; ditto, final speed 1 rev 1½ mins. approx. 13/6 each, post paid.

INDICATOR UNITS TYPE 184A.—Fitted 3in and 6in cathode ray tubes type ACR.10 and V.C.R. 517B, and 17 valves, viz., 6 V.R.92; 5 V.R.91; 3 V.R.54; 3 V.R.65; metal rectifiers, chokes, transformers, potentiometers, resistances, condensers, etc., £3/10 each, carriage 10/-.

CRATER rotary switches, 250v 10amps ac single pole 3-way series; parallel; ideal for photo floods, etc.; price 4/- each or 40/- per doz., post paid.

PERFORMANCE meters type No. 2 fitted standard mains 230v ac 50 cycle power pack, 2 V.R.91, 1 V.R.137, 1 5Z4G, 1 C.V.51, 1 V.R.92 and other useful components; £2/5 each, carriage 5/6.

AC mains 230v 50 cycles power packs with variable output, 300v dc at 10 ma, to 200v dc 2½ma, housed in nicely finished metal cabinet size 11in×6½in×6in complete with 5Z4G rectifier, also gives 18v ac ½amp, £2/10 each, post paid.

A LARGE quantity of single items which we do not list, which are available to callers; also assortment of various ex-W.D. radar and radio equipment, relays, power packs, oscillograph units, gears, photographic apparatus, s.a.e. for lists.

H. FRANKS, 58, New Oxford St., London, W.C.1. One minute from Tottenham Court Rd. Station. Tel. Museum 9594. [0057

HAVE you received our latest lists yet? If not, send s.a.e. without delay; enormous stocks of ex-Government radio and television equipment for disposal; specimens as follows: 22ft steel television masts, £1; di-pole insulators, 5/-; type 19 receivers (partly stripped) 12/6, and a host of other bargains; don't delay! Write to-day! To

MAIL orders, Walton's Wireless Stores, 203, Staveley Rd.;

CALLERS only, 48, Stafford St., Wolverhampton. [0061

BRAND-new ex-R.A.F. power units containing 0-1ma m/c meter, meter rectifier, 2 x 32 mfd, 600UDC condensers, 2 x 300ma 20 Henry l.f. chokes, heavy duty mains transformer input 230 volts 50 cycles, output 350-0-350v at 300ma, 2 x 6.3v, 5v, 20-0-20v, 2 x EF50, KA50 5U4G. Condensers, resistances, thermal delay switches, fuses, etc., all in wooden packing case, bargain at £6/15, carriage paid.

TELEVISION—5000v rectifier V1907/960 4v fil. 6/-; conds. 0.25 1000v, 8/- doz; 0.05 2.5kv, 0.05 3.5kv; 1/- each; 0.1 6kv; 5/6 ea; 4mf 425v micropacks; 10/6 doz; condensers 0.01 1000; 5/- doz; 0.25 500; 3/6 doz; 0.25 1000; 6/6 doz. 4mfd; 1/- ea; many other items; s.a.e. list.—Cross, Skerries, Cross Lane, Grange, West Kirby, Cheshire. [4749

GALPINS

ELECTRICAL STORES

408 HIGH STREET, LEWISHAM, LONDON, S.E.13

Telephone : Lee Green 0309. *Near Lewisham Hospital*

TERMS : CASH WITH ORDER. NO C.O.D.

PRE-PAYMENT 1/- SLOT ELECTRIC LIGHT CHECK METERS, all electrically guaranteed, 200/250 volts 50 cys. 1 ph., A.C. input, 2½ amp. load, **27/6** each ; 5 amp. load, **35/-** each ; 10 amp. load **42/6** each ; 20 amp. load, **50/-** each, carriage 2/- extra ; in quantities of one dozen or more a special discount of 10%.

MAINS TRANSFORMERS, 200/250 volts 50/1 ph., in steps of 10 volts. Output 500/0/500 volts 300 m/amps., 6.3 v. 8a., 6.3v. 8 a., 6.3v. 4a., 5v. 4 a., 4v. 4 a., at **67/6** each ; another same input, outputs, 450/0/450 volts 300 m/amps, 6.3v. 8 a., 6.3v. 8 a., 4v. 4 a., 5v. 4 a., at **62/6** each.

POWER TRANSFORMERS AUTO WOUND voltage changer tapped 0, 110, 150, 190, and 230 volts at 1,600 watts, **£3/5/-** each, carriage 3/6 ; ditto 2,000 watts, **£6/5/0** each, carriage 3/6 ; another tapped 0, 110, 200, 230 volts at 350 watts, at **47/6** each, carriage 2/-.

ELECTRIC LIGHT CHECK METERS, quarterly type, for sub-letting garages, apartments, etc., all fully guaranteed electrically, for 200/250 volts A.C. mains 50 cys. 1 phase, 5 amp. load, **17/6** each ; 10 amp. load **20/-** ; 20 amp. load, **25/-** each ; 50 amp. load **37/6** each ; 100 amp. load **45/-** each ; carriage 2/- extra on each ; special discount of 10%, on quantities of one dozen or more.

ISENTHAL MAIN VARIABLE Resistances (Dimmers) 700/750 watts from full bright to b/out worm wheel control, as new **27/6** each, carriage 2/- total resistance 60 ohms.

EX R.A.F. ROTARY CONVERTORS, D.C. to A.C., 110 volts D.C. input, 230 volts A.C. 50 cycles at 250 watts output at **£7/10/0** each, carriage 7/6 ; another 24 volts D.C. input 50 volts 50 cycles at 450 watts output at **£4/10/-** each, carriage 7/6 ; another 24 volts D.C. input 230 volts 50 cycles at 100 watts output at **£3/5/-** each, carriage paid, another 24 volts D.C. input 50/100 volts 500 cycles 1 phase at 300 watts output at **82/6** each, carriage paid. All these convertors are by well known makers, condition as new.

MAINS TRANSFORMERS INPUT 200/250 VOLTS, 50/1 in steps of 10 volts, output tapped 0, 6, 12 at 24 volts at 10/12 amps., **47/-** each ; ditto as above but at 25/30 amps. output, **[illegible]** each.

MAINS VARIABLE SLIDER RESISTANCES, protected type by well known makers, 450 ohms, .9 amps., **22/6** each ; ditto 1,500 ohms to carry .45 amps, **22/6** each, not protected, 0.4 ohms to carry 25 amps., **10/-** each ; 14 ohms to carry 1/4 amps., **12/6** each ; 5.7 ohms to carry 8½ amps, **15/-** each ; 60 ohms to carry 1½ amps, **15/-** each.

MAINS TRANSFORMERS, input 200/250 volts in steps of 10 volts, output 350/0/350 volts 300 m/amps, 4 volt 8 amp., 4 volt 4 amp., 6.3 volts 6 amp., 6.3 volts 2 amp, tapped at 2 volts (electronic) at **57/6** each ; another same input as above output 500/350/0/350/500 volts 250 m/amps 5 volts tapped at 4 volts 4 amps twice, 6.3 volts tapped at 2 volts 2 amps., **67/6** each.

SWITCH-BOARD A.C./D.C. AMPMETERS, 0 to 14 amps. 4½in. scale by well known makers, as new, **25/-** each.

MAINS TRANSFORMERS, 200/250 volts input in steps of 10 volts, output 350/0/350 volts 180 m/amps. 4 volts 4 amp., 5 volts 3 amp., 6.3 volts 4 amp., **37/6** each, ditto 500/0/500 volts 150 m/amps 4 volts 4 amp., 5 volts 3 amp., 6.3 volts 4 amp., **42/6** each ; ditto 425/0/425 volts 180 m/amps, 6.3 volts 3 amps twice, 5 volts 3 amps. (Williamson Amplifier), **39/6** each ; Ditto, 350/0/350 volt 180 m/amps. 6.3 volts 8 amp. 5 volts tapped 4 volts 3 amps., **39/6** each.

PRE-PAYMENT 1/- SLOT METERS for 230 volts D.C. mains 10 amp load, calibrated ½d. P.U. as new electrically guaranteed, **30/-** each, carriage free.

CELL TESTING VOLT-METERS, moving coil, reading 3/0/3 volts by well known makers, complete with test loads, **7/6** each.

EX R.A.F. ALTERNATORS, 230 volts 50 cycles input, 250 volts 625 cycles 1 phase output at 60 watts. These are separately energised by 24 volts at 0.4 amps., **65/-** each, carriage 5/-.

STUD SWITCH-ARM VARIABLE RESISTANCES, 2,700 ohms to carry 0.27 amps, **17/6** each ; another 10 ohms to carry 9/18 amps, **35/-** ; both these can be used as dimmers. Fixed wire wound resistances 350 ohms to carry ½ amp. A slider can easily be fitted, **5/-** each.

AMERICAN-MADE CONTROL BOARDS containing three 100 watt Variac transformers variable, all these are slightly damaged, also switches, and a synchronous 110 volt motor geared, **20/-** each carriage paid. A few only to clear.

I.F.F. UNITS, EX R.A.F., containing 10 valves all useful, also a 24 volt input 450 volt output rotary transformer and many useful condensers and resistances. The rotary transformer can easily be arranged to work off A.C. mains as a motor, approx. ⅛ h.p. A few only, to clear, **20/-** each, carriage paid.

MAINS TRANSFORMERS, 200/250 volts input in steps of 10 volts, output 350/0/350 volts 300 m/amps, 4 volts 4 amp., 5 volts 4 amp., 6.3 volts 8 amp., 6.3 volts 8 amp, **62/6** each. Smoothing chokes 10 Henry 100 m/amps, 200 ohms D.C. resistance, **5/-** each.

EX G.P.O. GALVANOMETERS, vertical type, reading 30/0/30 polarised, **8/6** each ; rectifiers, output 50 volts 1 amp. D.C. from a 70/75 volt A.C. input, **8/6** each, post 1/6.

METERS ALL BY WELL KNOWN MAKERS as new, 2in. scale moving coil 0 to 20 volts, **5/-** each, 0 to 40 volts **7/6** each, 0/10 amps. **12/6** each, post 6d. Thermo coupled 2½in. scale 0 to 4 amps. **7/6** each, 2½in. A.C./D.C. 0 to 20 volts, **10/-** each.

EX. GOVERNMENT AUTO WOUND TRANFORMERS (as new), 1,000 watts output, 115/230 volts or vice versa, **£4/10/-** each, carriage 5/- ; another 1,000 watts from 5 to 230 volts with 32 various tappings inclusive of 110, 150, 60, 90 etc., etc., all tapping at 1,000 watts **£5/10/-** each, carriage paid.

MAINS TRANSFORMERS 230 VOLTS, 50 cycles 1 phase input/output, 4 volts 5 amps three times, **16/-** each ; another 6.65 volts 5 amps twice **16/6** each ; another input as above, output 150/0/150 volts 150 m/amps, 6.3 volts, 8 amps, 5 volts 2 amps, **16/6** each ; all carriage paid.

EX GOVERNMENT CHARGING SWITCH BOARDS, 550 watts containing five moving coil 2in. scale volt and ampmeters, five variable resistances, three cut-outs, good condition, at **75/-** each, carriage 5/-.

MAINS BOOSTER TRANSFORMERS, 1,500 WATTS, tapped 0, 6, 10, 19, 175, 200, 225, 240, and 250 volts, good condition, electrically guaranteed, **£4/10/-** each, carriage 5/- ; another double wound 4,000 watts, 130 to 250 volts or vice-versa **£7/10/-** each, carriage 10/-.

D.C. MOTORS 110/230 VOLTS, rated at 1/12th h.p. with laminated fields suitable when fields are rewound for A.C. mains, **17/6** each ; ditto half the above size, **10/-** each ; another 100 volts D.C. approx ⅛ h.p. shunt wound solid field, 1,500 R.P.M., **10/-** each.

EX. R.A.F. CRYSTAL MONITORS (less valves and crystals), sold for component value only, containing many useful parts, condensers, resistances, transformers, the whole a very good basis for a miniature 3-valver, complete in wooden carrying case (condition as new), **5/-** each, post free.

EX. NAVAL CATHODE RAY INDICATOR UNITS, as new, containing loads of very useful components condensers, resistances, transformers, chokes, etc., etc., weight 90 lb. last few to clear, **25/-** each, carriage paid.

MAINS TRANSFORMERS, 230 VOLTS INPUT, 525/0/525 volts 150 m/amps, 6.3 volts 5 amps., 5 volts 3 amps., 55 volts 50 m/amps output, **30/-** each ; another 12 volts 12 amps output, **27/6** each ; another tapped 35 at 45 volts at 20 amps. output, **65/-** each.

A.C. MOTORS, 230 VOLTS, 50 cycles 1 phase, 2,800 R.P.M., induction type, ⅛ h.p., **95/-** each ; ditto 110 volts 1/3rd h.p., 1,425 R.P.M., **75/-** each ; also a few only approx. ⅛ h.p. windings not known, **35/-** each, with both wound armature and fields.

ALL GOODS SENT ON 7 DAYS' APPROVAL AGAINST CASH, all letters answered. We regret we have no lists available at present. We would be pleased to quote.

THE
BRITISH NATIONAL
RADIO SCHOOL
ESTD. 1940

To get into the B.N.R.S

CASH is NOT ENOUGH

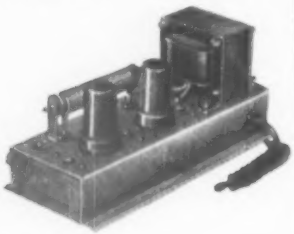
We must first be convinced that YOU are going to BENEFIT!

Write and tell us of your background and AMBITIONS and we will advise, not lure.

A.M.I.E.E. (in approved cases), Brit.I.R.E., City and Guilds, P.M.G. (Theory only) Examination Courses, also what we sincerely believe to be the best RADAR Course ever written.

STUDIES DIRECTOR
BRITISH NATIONAL RADIO SCHOOL
66, ADDISCOMBE ROAD, CROYDON
Phone: Addiscombe 3341

TELEVISION
PRE-AMPLIFIERS
FOR BIRMINGHAM FREQUENCY



SPECIFICATION:

Two stage high gain low noise having adjustable sensitivity. Bandwidth 3-4 mc/s. Completely self contained, operates from 200/250 A.C. 50 cps.

Ideal for long distance operation of standard commercial receivers.

Price £5 . 15 . 0 post paid

CABOT RADIO CO. LTD.
28 BEDMINSTER PARADE,
BRISTOL 3.
Tel.: 64314

RADIO CLEARANCE, Ltd., 27 Tottenham Court Rd., London, W.1. Tel. Museum 0191. Brand new high fidelity amplifier kits for construction: the M-Mirdle 8-valve AC/DC amplifier for impedance input (suitable for moving coil mikes, etc.), by triple shielded trans to E.F.57, R.C. coupled to triode stagged stage, EF37, with switched bass and top cut, pentode trans coupled to output stage using four CL33's in parallel push pull, large O.P.T. matches to 10 or 15Ω rectifiers two DRSC's parallel alternative high impedance input to second stage for Xtal pick-ups, tuners, etc., required inputs for full output, high imp. 0.5v r.m.s., low imp. 1mV/cut. V.C. operates on both inputs, chassis isolated from mains, complete kit of first-class comp. items, including Partridge trans., all valves, black crackle chassis (ready drilled), black crackle and chromium case (15½ x 8 x 5in.), circuit diagram, etc., everything required for the construction of a fine job, £13 15s. carr. paid.

MANSBRIDGE Condensers, 4mf 1,000v WKG (4½in. x 4in. x 1¾in.), 4/-; 4mf, 2,000v Test (5in. x 4in. x 1¾in.), 4/-; 2mf, 2,500v Test (4½in. x 3¼in. x 2¼), 2/6; 25mf (7in. x 5in. x 2in.), 10/-; 2mf, 5,000v Test, 5/6; 2mf, 2,500v WKG (3in. x 2½in. x 2½in.), 4/-; post extra.

PERSONAL receivers, 5-valve T.R.F. receivers using LT4's, contained in handsome Bakelite case, with lift up lid, size 7in. x 5½in. x 5in. with lid closed, plastic carrying handle, frame aerial in lid, these receivers cover the medium waveband and operate from self-contained, standard size, dry batteries, types W1435 and 02, output to a pair of lightweight high resistance phones, 2 easy knob with r.m.d., opening the lid switches on, supplied brand new in maker's carton, with valves, phones and batteries, an ideal set for children, invalids, and many other purposes, these receivers are not Govt. surplus, and are offered ready to play, £7/15/0, carr. paid.

I.V. line transformers, shielded in alt. can, with T.C. lead (used with PR3Mic), 11/6; chassis steel, 5½ x 3½ x 1½in. drilled 4 button base holes 2 x 3/8; 4½ x 2½ x 1½in. drilled 7 button base 2 x 3/8; alt 17 x 14½ x 2½in. drilled 7 int. oct. and square open-ends, 5/3; E.H.T. trans. 4kv 1ma 2v 2a Pri. 250v 50c/s, 29/6; rec. B. 1461 cover 65-80Mc/s, 10/ valves 1/8/61; hobbs insertion SM dial, circuit diagram, etc., brand new in transit case, £4/4, carr. paid; personal receivers B.C.12G. 7 valve rec using 1.4v valves, with 4 push buttons covering 2-6Mc/s, built in L/S, supplied brand new complete with valves (1T4, 1R5, etc.), 2 and 12v Vib. p.s. in cabinet, A.C. operation, 6v etc., £6/19/6; auto trans. 200-250v-110v, 60W etc., rating enclosed, 18/-; special line auto 250/- 110v, 100W, 9/6; smoothing chokes 5H 120mA, 14/3; 5/3; 3H 200mA, 10/3; 4/11; 8H 250mA, 18/6; 6/6; 12H 250mA, 30/3; 7/6; electrolytics, 8mf, 150v, 1/3; 8/170v, 1/3; 8/450v 2/3; 16/350can, 2/3; 16+8/450v, d-ended 3/6; 8+32 450v can, 4/-; 32/450 large can, 3/9; 16+8 450v can, 5/-; 60+100/350v can 8/-; 32/350v cart 3/3; 100mf 6v, 6d; 25/25v, 1/3; 100/25v, 1/6; 25/50v, 1/3; 16/350 card, 1/9; 24/350 can, 2/-; 8+24 450v can, 2/6; P.M. loudspeakers 5in less trans., 9/11; with trans., 4/5000, 11/6; 6½in less trans., 10/11; 10in with trans., 21/-; output trans. 2,000/2½, 2,500/2½, 2,750/3½, 3,000/3½, 4/-; 4,500/2½, 5,000/4½, 5/6 3 ratio 7,000/5 500/7,000/4½, 4/-; 10,000/2½, 7,500/2½, 5/6; mains condns., 0005 ceramic ins., 1in standard spindle, 4/6; ceramic switches 2p., 5w., 1b., 2/-; 3p. 1b. 2/-; switches, standard size 2p., 3w., 1b (additional wafer available), 1/6; 1p., 1w., 1w. 2b., 2/6; 3p., 1w., 2b., 2/6; all have fin spindles; resistors 100 assorted, 17 values ranging 10Ω-100K 5w., standard sizes, best make, 17/6; 100 assorted carbon, 5 values 5 watt, 15/-; var. 1.5, 3/15pf single, 3d; 5.50pf air spaced concentric, 6d; 8.25pf D.I.C. type, 9d; air spaced variable 3in spindles 25pf, 50pf straight, 50pf dual ceramic bases, 1/-; 50pf butterfly, 1/6; 9-way radio vibrator packs with 12v 4 ma V10 and OZ4 valve on chassis 5½ x 3½ x 1½in., 250v 60ma output brought out on 6ft screened lead, 17/6; speaker moving coil, metal cased, 2in circular 0-500 m/m A, 7/6; 0-15/600 res. ext. res. 8/6; 0-20 or 0-30A with shunt, 5/-; Bakelite cased 2½ square 0ma A, 7/6; 0-50mA, 6/-; 0-500mA, 7/-; 0-1Kv series res., 6/-; Bakelite cased 2½in circular, 0-500m/mA, 16/6; 0-50mA, 7/-; 0-50mA, 8/6; 0-100mA, 8/6; 0-200mA, 8/6; 0/15, 7/-; 1mA desk type, 15/-; visual indicators type 1 receiver results, 2/6; 3 amp fuse 60m/m with makers, 5/-; S.M. dials as on R.F.28, etc., 5/11; ex Admiralty pattern 1257, 18gin engraved 0-180, fast slow 150-11, panel mounting, fits 1½in spin., 2/6; rotary power units type 104 12v D.C. input, output 250v 60mA 6.5v 2.5mA P.M. rotary mounted on chassis with supp., 6/11; type 87 output as above but 24v input, 5/11; 10-valve receivers, R.109 ARC3 type, 100-156 Mc/s, brand new with valves (inc. 4-717 A.C.), 42/6. Wilcox Gay V.F.O. covers 2-16 Mc/s, with 0-10 mA meter, supplied brand new in original carton with full accessories, plugs, leads, etc., and instruction book, £5/5/0, paid. Wilcox Gay Xtal multipliers 2-7 Mc/s, brand new, with eff. plugs, leads, instruction book, etc., in original cartons, 49/-, carr. paid; superior mains transformers M.W., HP, AE, osc., L.W., HP, AE, osc., 1/6, per roll; I.F. traps (non cored 465 Kc/s) 1/6, set of 6 coils and trap 9/6; 7 or 10 pin plugs and sockets with earthed 1/6 per pair; 2-way plugs and sockets with cover, 1/6 pr. V.C. carbon with sw., 2-pin spindle 5K, 25K, 50K, 100K, 250K, 1/-; 5 watt wire-wound, 10 ohm x 2, 2.5K, 2.5K, 2.5K, 500/500/2.5K, 5K, 50K, 50K, 5/-; twin carbon 1m/1m, 2/6; all telescopic aerials, 15in closed 7ft 6in extended, 3/6; receivers type 78, 150/505 Kc/s, 3 valves ARTH, VR18, VR92, I.F. output 465 Kc/s, brand new, in transit case, 22/6, carr. paid. Bakelite cases with lid, inside meas. 6in x 4½in x 3½in, without lid, lid 1in deep, with former for frame aerial, 5/6

(Continued on page 85)

NO NOTES CHANGED
if you use the following

AMPLIFIERS

Leak "T.12," Vortexion "Stereophonic," Williamson, Sound Sales "Tonemaster."

SPEAKERS

Wharfedale S.F. New Corner, Tannoy "Dual Concentric," W.B. £6 6 - "Concentric Duplex," Barker 180 and 148a, also our matched pair with crossover, 14 gns.

PICK-UPS

Decca, Acos, Connoisseur, Brierley.

FEEDER UNITS

Leak P.B., Sound Sales DX, Plus One and Two and new Ruco type E. Other lines include Armstrong Chassis Autochange Units and FFrr Records.

Call and hear them at:

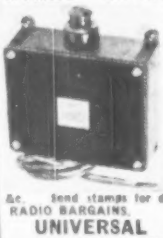
HOLLEY'S RADIO STORES
285, Camberwell Road, S.E.5
'Phone: RODney 4988

200/250 volt A.C. MOTORS

APPROX. EIGHTH H.P. Revs. 2,000. Carriage and Packing 3 - extra. EACH 55/-

ALDIS LAMPS 32/- EACH
STAGE SPOT LIGHTING, PHOTOGRAPHIC WORK etc. Post Free

MAINS INTERFERENCE SUPPRESSORS



Rid your set of all noises from the MAINS

21/- each

POSTAGE 1/-. Large Stocks Resistances, Condensers Speakers, Valves &c. Send stamps for descriptive leaflets of RADIO BARGAINS.

UNIVERSAL BAZAARS
(M/c.), Ltd., 8-10 BROWN STREET, MANCHESTER, 2 (DEAnsgate 5009)

LIQUIDATORS DISPOSAL AGENCY

(RADIO & ELECTRICAL)

BARGAINS DIRECT FROM OWNERS

Grampian Latest Model 50 Watt Amplifier, A.C., with 4 special cabinet speakers, 2 Grampian M/C. Mikes and stands. Cost £145/-/-. As new. Our price **£85 0 0**

Trix 60—100 Watt Rack Amplifier, 200-250 volt A.C. mains. Complete with Radio, Moving-coil Mike and Gram Inputs. Cost £140/-/-. Our price **£32 10 0**

1948 Emor Globe Radio Sets. 3 wave-band, 6 valve, superhet. Less valves. All valves octal base standard types. Cost £25/-/- each. All guaranteed in perfect working order. In chrome, gold and other colours. Our price **£6 10 0**

Latest Model Minniphone Inter-communication Sets. Complete with Master Unit, 4 extensions and Car Radio Adaptor. Can be used as Radio or Intercom. As new........ **£22 0 0**

Pye Service Workshop Test-Rack, absolutely perfect **£27 10 0**

Hallicrafter's S27 Receiver, complete and perfect........ **£27 10 0**

Weston Master Valve-Tester, perfect **£16 10 0**

½ h.p. **Motors** (new), 220-240 volts A.C., 1 phase, 50 cycle, 1,425 revs. per minute. Famous make **£7 10 0**

G.E.C. 2½ Kilowatt Fan Heaters, complete with fuse-box. Perfect. Cost £12/10/- each. Our price........ **£5 10 0**

1939 H.M.V. Radiogram, 9 valve Auto-change, 4 wave-band. In really first-class cabinet. Complete and perfect **£60 0 0**

Sun-Ray Lamp on 5ft. 6in. Stand. Perfect and complete........ **£12 0 0**

1949 Pye Personal Portable Radios. Complete and perfect. Each **£8 0 0**

1950 Romac Personal Portable. Perfect **£9 10 0**

Ekco Princess Portable, complete and perfect........ **£8 10 0**

Mark 19 Tank Set, complete and perfect **£11 0 0**

Recording Motor, tracking gear and cutting-head mounted on metal plate. Perfect **£13 10 0**

WE WELCOME CALLERS!

We have other bargains arriving daily

Cash with orders only.

All items carriage extra.

PHONE: GERRARD 8582

39a, LISLE ST., LEICESTER SQUARE
LONDON, W.C.2.

(Continued from page 84)

requires fixing, ideal for personal sets, multi meters, etc., 6/6, post paid; .00045 2 gang condensers with epicyclic drive, ceramic ins., 4/-; lightweight high resistance headphones, 2,000Ω 5/11 pair; electrolytics 32+32mf 350v can, 3/6; T.V. scanning coils, low imp. line and frame, as Viewmaster, 12/6.
RADIO CLEARANCE, Ltd., 27, Tottenham Court Rd., London, W.1. Tel. Museum 9188. [0015

CO-AXIAL double end plugs 1081/618, 2/- dozen; rheostats 15ohms 1.5amp, 12ohms 2.0amp, 15ohms 1.76amp, all 4/- each; solar 0.1 mfd 7500 volts, 7/6; insulating tape, 1in, ½lb, 1/6; Westectors W.1, 1/-; hot wire ammeters, 4½in dial 0-2amp, 5/6; M.I.L. 5amp 2-pin socket (surface) and fused plug, 2/-; small auto-trans 230/110, 8/6.
PASSINGHAM, 95, North St., Keighley. [0002

RECTIFIERS, 12v 1a 5/6, 12v 4a 14/-, 5a 4a 35/-, all sizes available; mains trans. 12v 5a, tapped every 2v, 15/-; mains units 12v 10a d.c., 12v 50a a.c. £3/10; meters 2-4in at low prices; many types w/w vitreous resistors 25ohm 1watt to 2,000ohm 50watt from 3/- per doz.; tone vol. controls 15,000 and 1meg 11d.; crystal oven thermostats 44 C to 47 C, 5/-; everything available, s.a.e. exact requirements.
C. J. EMMS, Ltd., 26a, Colehorne Mews, S.W.10. Fremantle 5941. [4669

BRAND new guaranteed goods. V/controls ¼, ½, 1 meg. w/switch, 3/9; condensers all 450v, 8mfd 2/-, 8×8 2/6, 8×8×8 2/9, 8×16 2/9, 16×16 3/4, midget 8×16 3/9, 32mfd 4/-; m/coil 0-40 ammeter, 3/11; M.I. 0-25 ammeter, 2/11; EF50 holders, 6d; 1mfd 450v, 7/6 doz; 5mfd 50v, 9/- doz; new midget relays, 1/6; twin coil buzzer, 3/6; 600hm headphones, 5/6; headlamp bulbs, 12v 60 watt, 2/6; 1436 twin twisted flex, plastic or c/covered, 25-yd coil, 7/6; red/black twisted plastic flex, 15/- 100yds; m/coil suspension type microphone, 50ohms, 55/-; folding chrom. mic. stand, 27/6; hundreds other lines, 1d stamp list.—Radio Unlimited, Elm Road, London, E.17. Key. 4815. [0062

4-VALVE short-wave receivers (6-9 mc/s), type 18, complete with 4 Mazda octal 2-volt valves, matched headphones with jack-plug and 90-volt H.T., only 25/6, post free; 6-volt vibrator packs, 150 volts, at 40ma, on small chassis 9¼×3¾×2¼, store soiled, 10/6, as new 19/6; output transformers, U.S. make, porcelain stand-offs, potted, pentode, push-pull or power, 4-hole chassis mounting, lovely job, weight 3¼lb, only 4/3; meters, R.F., 0-5 amp, 0-2.5, 0-6, 3/6; D.C., 0-500ma, 3/6 each; 0-300 volts, boxed and new, 5/-; U.S. make 115v blower heaters, as new, 35/-; small blowers, 12/24v D.C./A.C., brand new, 2 to a box, 18/6 the two, or 10/- each; bargains for callers, such as communications receivers, from £5.—Haynsons, 14, St. Mary's, Bedford. [0012

LONDON CENTRAL RADIO STORES.—Set of 4 heavy contacts for relays, etc., new, 2/-; ex-G.P.O. plug and jack, 2/-; throat mikes with plug and cord, 5/- pair; low resistance headphones, new, 4/6 pair; projector lamps, 12v 100 watt, new, 3/6; camera motors, 24v, ex-R.A.F., new, 7/6; centrifugal fans, 50v, new, 4/6; large terminal strips with 20 heavy brass terminals, 2/9; new carbon mike inserts, 2/-; moving coil inserts, 50 ohms, for miniature speakers, mikes, etc., 2/6; hand generators, 4/5; 4-blade selector switches, 5/6; high voltage relay, 1,000 ohm, 2/6; ex-Govt. copper aerials, 100ft, with ebonite insulators, 4/5; table stand mikes (carbon), 6/-; 2in Magslip receivers, Mark II, 3/6; see our displayed advert P. 85.—London Central Radio Stores, 23, Lisle St., London, W.C.2. [4991

H.R.O. receivers from £12/10; General Electric wire recorder as new £75; Hallicrafters S27, SX24, R.C.A. types, AR77, AR88LF, ex-Army 107 receivers, German short-wave sets from stock, rotary converters, all voltages and wattage; amplifiers 200-250v 50cs 20 watts, less valves £4/10, valves for same MH4, ML4, PP5/400, MU14; large selection of L.T. transformers, 6v to 50v; all ranges of meters in stock, including H.R.O. "S" meters; mag slips in pairs, boxed, new £5/5; small relays 2,000Ω 7/-; 522 transmitter chassis 5/6, less valves; special offer of new meters, 5MA 6/6, 100MA 7/6; 5 thermo-amp meters 5/6; all 2in scale small motors 12v-24v 9/6; ex-Govt. hall and biscuit mikes £5; Avo adaptors, new, in boxes, 12/6 each; A.C./D.C. gram motors, record changers, etc.; Hammarlund super-pro with power unit, as new £45 to £91; large energised speakers, G.12 Magnavox "66," Rola energized 6½in 9/6; Co-axil lead 10d yd; air temp. meters 4/6; all prices include postage.
SERVICE RADIO SPARES, 4, Lisle St., London, W.C.2. Tel. Ger. 1734. [5019

NOTICES

BRITISH SOUND RECORDING ASSOCIATION.
MEMBERSHIP is open to all professional and amateur recording engineers; high quality reproduction enthusiasts are also specially catered for.
THE B.S.R.A. Diary for 1950 is available to non-members, price 4/6; it contains valuable data on recording and reproducing topics, full information, with brochure and membership application form from the Membership Secretary: Harrie J. King, 42, Mount View Road, North Chingford, London, E.4. [2119

WANTED, EXCHANGE, ETC.

FINE wires in large quantities only; must be new and perfect material.
L. E. SIMMONDS, Ltd., 8a, Byron Rd., Harrow. Tel. Harrow 2524 and 0135. [3661

WANTED, Hartley Turner or similar, tunable heterodyne filter.—Box 2010. [4913

WANTED, Magnetophone tone B with spares (amplifier not required).—Box 1069.

VOIGT H.C. corner horn, bass chbr.—F. Barker, 5, High St., Swanscombe, Kent.

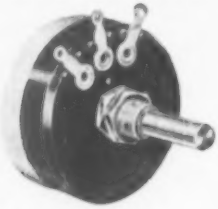
SOUTHERN RADIO'S WIRELESS BARGAINS

R.A.F. BOMBSIGHT COMPUTERS. Complete with motors, gyro, blowers, gears, etc., etc. Ideal for model makers and experimenters. The best component value ever offered. **55/-,** plus 5/- carriage.
SERVO UNIT ASSEMBLY for bombsight computer, including 27 volts motor, gearing, blowers, etc., **17/6.**
CONTACTOR TIME SWITCHES. 10-hour movement with thermostatic control. 2 impulses per second. Complete in sound-proof case, **10/-,** plus 1/4.
AUTO-TRANSFORMERS. Step-up or down 230 volts to 115 volts, 500 watts, **70/-** each.
DELCO HAND GENERATORS. 6 volts at 4 amps., complete, ready for use, **17/6.**
LUCAS GENERATORS. 12 volts input to 480 volts output D.C., **10/-.**
PERISCOPES. Ex-U.S.A. Type M.8, complete with removable telescope, **17/6.**
COMMAND RECEIVERS, B.C.454 (49/103 metres), B.C.455 (33-49 metres). Complete with 6 valves. Ideal for easy conversion to mains receivers or car radio, **35/-,** plus 1/4. Conversion circuit to mains, etc., **1/6.**
CRYSTALS. American and British 2-pin types. A fair assortment of frequencies from 2040 kcs. upwards, **6/-** each. Twelve assorted frequencies, **60/-.**
CRYSTAL MONITORS. Type 2. Complete in case, less crystals, **6/-.** With 2 crystals, **16/6.**
CAMERA CONTROL UNITS. Type 35 No. 26. Complete in wooden box, **20/-.**
LUFBRA HOLE CUTTERS. Adjustable from ⅜inch to 3½ inches. For use on wood, metal, plastic, etc., **5/6.**
RADIO COMPASS INDICATORS, with Selsyn motor, 3-inch dial 360 degrees, **13/6.**
ROTOTHERM Temperature gauges, from 200 to 500 degrees Fahrenheit. Chromium finish, **6/-.**
SECTIONAL AERIALS. 8-feet interlocking, **3/6,** base for same **2/6.**
WESTECTORS. Wx6 and W112 types, **7/6** per dozen.
THROAT MICROPHONES. Complete with lead and plug, **3/6.**
MICROPHONES. Made by Electro-voice. Lightweight carbon type, **5/6.**
CRYSTAL DETECTORS. Semi-permanent type, **2/6.**
RESISTANCES. 100 Assorted values, from ½ watt to 3-watts. All useful values, **9/-** per 100.
CONDENSERS. 100 Assorted values. All useful sizes. Mica and tubular, **15/-** per 100.
INDICATOR UNITS. Type BC 929A, 7 Valves 2X2 (1) 6X5 (1), 6H6 (2), 6G6 (1), 6SN7 (2), 3 BPI Tube, switching motor, etc., etc. Ideal for Oscillator conversion, **44/-,** plus 5/- carriage.
R.T. TESTERS. Complete with two valves. Contained in useful metal carrying case. Ideal for tools, etc., with carrying handles, **12/6.**
DRIVE CABLES, for B.C.453/4/5. 14-feet long with adaptors at either end. **8/6,** post 1/- extra.
TELEPHONE LINE UNITS. Complete in polished box. Relays, Switches, etc., **5/-.**
BRAZING LAMPS, 5-pint size with extension hose and nozzle, **40/-.**
WAVEMETERS. Class C. Complete in metal carrying case. Used but perfect, **30/-.**
MORSE TAPPING KEYS. **2/-** each.
MICROPHONE TRANSFORMERS, 3/6.
TELEVISION MASKS. Rubber, 9in., **12/6.**
SIGNALLING LAMPS. 6in. lens. Complete in transit cases with 3 bulbs, cable, etc., etc., **40/-.**
RADIO RECEIVERS TYPE R-28 ARC-5. Complete with 10 Valves, 717 (4), 12SH7 (3), 12SL7 (2), 12a6 (1), etc., etc. 100-156 Mcs., designed for Crytsal Control, **55/-,** plus 5/-. Full List of Radio Publications, **2½d.**

THOUSANDS OF BARGAIN LINES FOR CALLERS.

Southern Radio Supply Ltd.
46 LISLE ST., LONDON, W.C.
GERrard 6653

POTENTIOMETERS



by RELIANCE

Wire wound and Composition types, Single, Ganged, Tandem Units.

Characteristics: linear, log, semi-log, non-inductive, etc.

Full details from

RELIANCE

Manufacturing Co. (Southwark) Ltd.
Sutherland Rd., Higham Hill, Walthamstow E.17
Telephone: LARkswood 3245

URGENTLY wanted, technical publications on Loran equipment, details and prices to Whitehall 9956. [4972

WANTED, push-button control unit for Murphy A72 receiver, or suitable M/F (mono-pole coils).—Box 3942. [4945

WANTED, surplus relays and push-button units, any condition, large or small quantities; highest prices paid.—Box 4505. [3552

WANTED, Hartley Turner 215 speaker in good condition, at reasonable price.—Robins, 18, Reservoir Rd., London, N.14. [4966

WANTED, Voigt speaker unit, one with damaged diaphragm acceptable at reasonable price.—46, Swanage Rd., Wandsworth, S.W.18.

WE pay top prices for used test equipment, all types.—University Radio, Ltd., 22, Lisle St., London, W.C.2. Tel. Ger. 4447 and Ger. 4989. [3992

WANTED, AR88Ds, SX28s, cash or part exchange, no objection slight repair.—P.C.A. Radio, Cambridge Grove, London, W.6. Tel. Rib. 8275. [3080

WANTED, all kinds of laboratory test equipment, standard signal generators, bridges, oscilloscopes, "Q" meters, etc.; send price and details to:
HATFIELD INSTRUMENTS, 175, Uxbridge Rd., Hanwell, W.7. Tel. Ealing 0779. [3037

WANTED, Ferranti amplifier book R105/AF9, AP105 transformers; state prices.—F. Forshaw, "Gipthesk," Flixton Rd., Urmston, Manchester. [4924

WANTED, 2-meter converter, with power-pack, or national 1-10A receiver; exchange for B-C348R, in brand new condition, fully modified 230V.—Box 2015. [4919

WE buy for cash, new, used radio, electrical equipment, all types, especially wanted: radios, radiograms, test equipment, motors, chargers, recording gear, etc. If you want to sell at the maximum price, call, write or 'phone to University Radio, Ltd., 22, Lisle St., Leicester Sq., W.C.2. Ger. 4447.

GOOD recorder, disc, tape or wire, 40w. Bass speaker, tweeter, Decca P.U., mixed autochanger, with Decca P.U., sound sales speaker and tuner, 6 G.P.O.-type desk telephones, Audio oscillator, e.g., BSR, EE or commercial television. 12in working or not.—
FOR sale, to clear, Lesington P.U., as new; 8 sales m/c mike, offers.
JOHNSON, Claylake, Endon, Stoke-on-Trent. Endon 2158. [5028

REPAIRS AND SERVICE

MAINS transformers rewound, new transformers to any specification.
MOTOR rewinds and complete overhauls; first-class workmanship, fully guaranteed.—
F.M. ELECTRIC Co., Ltd., Pontes Bldgs., Warner Gate, Nottingham. Est. 1917. Tel. 5653.

LOUDSPEAKERS and transformers rewound, cones replaced, prompt service.—Dodds Radio Service, 53a, Bullingdon Rd., Oxford.

MAINS transformers rewound or constructed to any specification; prompt delivery.—Bede Transformer Co., Ltd., Bedesway, Bede Trading Estate, Jarrow. [3198

MAINS transformers rewound or constructed to any specification, prompt deliveries.—Avon Transformer Co., 20, Heath Terrace, Leamington Spa, Warwicks. [4498

REPAIRS to moving coil speakers, cones, coils fitted, field rewound or altered, speaker transformers, clock coils rewound; guaranteed satisfaction, moderate.—
L.S. REPAIR SERVICE, 49, Trinity Rd., Upper Tooting, London, S.W.17. Balham 2359.

ALL types of ammeters, voltmeters, Avos, etc., repaired, quick, efficient service, estimates free.—Depwin Instrument Co., 91, Philbeach Rd., London, W.14. Tel. Park 4469. [3059

A REWIND service which duplicates or modifies as required; transformers, loudspeakers, etc., prompt returns.—Radel Services, 49, Lr. Addiscombe Rd., Croydon. Cro. 6587.

ELECTRICAL measuring instruments of every make repaired and standardised.—The Electrical Instrument Repair Service, 329, Kilburn Lane, London, W.9. Tel. Lad. 4166. [3715

SINCLAIR SPEAKERS.—Owing to removal to a new factory, the speaker service is temporarily suspended.—Sinclair Speakers, 5 and 6, Manor Way, Borehamwood, Herts. [5001

REPAIRS.—E.H.T., mains and O.P. transformers, field coils and chokes; also armatures and motors; new transformers designed to any specification; all work fully guaranteed.—
WILLESDEN TRANSFORMER Co., Ltd., 793, Harrow Rd., N.W.10. Tel. No. Ladbroke 2846.

SERVICE with a smile.—Repairs of all types of British and American receivers, coil rewinds, American valves, shaver line cord.—F.R.I., Ltd., 22, Howland St., W.1. Museum 5075. [1570

RADIO MAINTENANCE SERVICE for guaranteed rewinds and repairs; armatures, F.H.P. motors, vac. units, portable tools, etc.; prompt deliveries.—139, Goldhurst Terrace, N.W.6. Mai. 6155. [4921

A SECOND-to-none rewind service, reliable, neat, return of post service; also television requirements promptly executed, EHT, LHT and heater transformers; stamp for quotations.—H. E. P., 137a, Ashton Rd., Oldham. [3519

24-HOUR service, 6 months' guarantee, any mains transformer rewound, mains outputs and f.s., etc., all types of new transf., etc., supplied to specification; business heading or service card for trade prices.—Majestic Winding Co., 180, Windham Rd., Bournemouth. [3178

METROPOLITAN RADIO SERVICE for rewinds, mains and E.H.T. transformers, chokes and field coils, delivery 3-5 days; new transformers designed and manufactured singly or in quantities.—Metropolitan Radio Service Company, 1021, Finchley Rd., London, N.W.11. Tel. Speedwell 3000.

THE AERIAL Q5R9

The first folded dipole multi-element television aerial in this country AND STILL THE BEST for LONDON or MIDLANDS.

Built of high duty alloys by experts in short wave arrays, these aerials give you

TELEVISION AT ITS BEST

★ **High definition**
★ **Low interference**
★ **Long Range Reception**

★ **Folded dipole for wide band pick-up.**
★ **Full resolution of sidebands, optimum gates.**
★ **Multi-element design for high forward gain.**
★ **Great strength, low windage, minimum weight.**
★ **Assembled in less than 5 minutes.**
★ **Designed and built on proven principles.**
★ **Plated steel parts ensuring positive contact.**
★ **Positive one-nut locking for elements.**
★ **Guaranteed for long range reception and against damage by 80 m.p.h. gales.**

★ **FD2**, Folded dipole with reflector.
★ **FD3E**, Folded dipole, reflector and director.
★ **FD3R**, Folded dipole, three reflectors.
★ **FDTS**, Folded dipole, twin arrays stacked.

THE Q5R9 SERVICE AERIAL

We also have a complete range of inexpensive aerials for the Service Areas.

THE RICHARD MAURICE EQUIPMENT CO., PORTSMOUTH ROAD, COBHAM, SURREY

LABORATORY TEST EQUIPMENT

is of little use unless it is accurate. All equipment sold by HATFIELD INSTRUMENTS is GUARANTEED equal in every way to the makers' specifications. All instruments are either new or reconditioned as new.

Mr. B. H. Hatfield welcomes old and new friends to his new laboratories at Hanwell where Radio and communication test equipment may be inspected.

A selection of our stock is as follows:

Signal Generators.
Type TF.144G by Marconi Instruments.
Type TF.517E by Marconi Instruments.
Type TF.390G by Marconi Instruments.
Type D.1. Advance.
Type 52. Cossor.
Type 106. Salford.

Oscilloscopes.
Type 1035 by Cossor.
Type 339 by Cossor.
Type 11 Ultra.

Valve Voltmeters.
Type TF.428A by Marconi Instruments.

Pulse Modulators.
Type TF.675A by Marconi Instruments.

Also we have in stock wavemeters up to 1000 Mc/s. Variacs, constant voltage transformers, frequency meters, precision attenuators, etc.

Send for lists.

HATFIELD INSTRUMENTS

175, Uxbridge Road, Hanwell, W.7.
Telephone: EALing 0779.

-towards perfection-

LOWTHER (P.M.2 – P.W.1) Loudspeaker

is the most outstanding combination for natural reproduction and therefore a PERFECT COMPLIMENT to your electro-acoustic equipment.

Complete speaker
£57 "in the white"
£65 veneered walnut

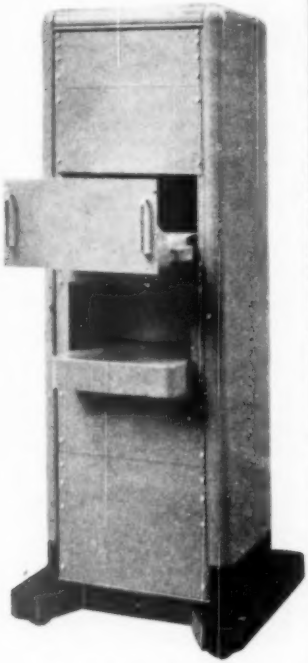
Further details, please write —

THE LOWTHER MANUFACTURING CO.

(The Laboratory Production Unit).

Lowther House, St. Mark's Road, Bromley, Kent RAV. 5225

STANDARD ENCLOSED RACK



Registered Design No. 858451

The Imhof 6ft. and 4ft. enclosed racks are standard articles, available from stock. They embody several unique features in their design. For example, both sides as well as back door are swung on lift-off hinges, and multiple units may be formed using only two end doors. Panels, chassis, chassis runners—telescopic and fixed, desk unit, gram unit and mobile base are all standard accessories.

Write for leaflet giving full details or catalogue of our complete range of standard cases, chassis, handles, etc.

IMHOF'S

112-116 NEW OXFORD ST., LONDON, W.C.1
TELEPHONE MUS. 7878 (20 lines)

RADIOS and televisors repaired, trade discount; assistance to home builders.—E. W. Shackle, High St., Harlington, Hayes, Middx.

STURDY rewinds, mains transformers, chokes and fields. First-class premises, deliveries and satisfaction guaranteed.—Sturdy Electric Co., Ltd., Dipton, Newcastle-on-Tyne. [4351

NATIONAL RADIO SERVICE & TELEVISION Co., radio and television development engineers; high quality receivers and amplifiers built to specification and modernised, repairs to all makes of receivers, transformers, coils, armatures rewound, loudspeaker cones renewed, television aerial installations, conversion, etc.—82, High St., St. John's Wood, N.W.8. Primrose 6723. [2671

WORK WANTED

WE make wireless and radiogram cabinets for home and export, immediate delivery.—Radiac (Exports) Ltd., 88/90, Caledonian Rd., London, N.1. Tel. Terminus 7447. [4025

EX-TRACER, 5 years' exp. exp. wishes to take tracing at home; contract pref.; please quote terms.—Mrs. Pritsel, 31, Hampden Way, N.14.

ADVERTISER, with most modern woodworking plant and capacity for assembly, can undertake large scale production of wooden radio cabinets.—Box 2006. [4301

SPECIAL receivers, test gear, electronic apparatus, (inc. experimental) and design work.—If you have a problem which needs expert handling, write in first.—Inglis, 5, Mount Pleasant, W.C.1. [4304

A.M.I.E. BCM HIFIDEL, London, W.C.1.

DRAUGHTING, tracing and photoprinting services, estimates free; contractors to the Ministry of Supply and the Admiralty for drawing and tracing work to their requirements and specifications, sub-contracting work of this nature undertaken.
DRAWING & TRACING, Ltd., 456a, Ewell Rd., Tolworth, Surbiton. Tel. Elmbridge 5606. [4181

MISCELLANEOUS

W.W. 1935-1947, same bound, 21 copies missing, £4 or nearest offer.—Box 2046. [4449

W.W. 1953-7, over 100 numbers, Short-Wave Magazine, 1946-9, 26 numbers; cheap.—Box 2007. [4300

WIRELESS Worlds, Jan. 1940 to date, 112 issues, offers to—Crouch, 141, West Town Lane, Bristol, 4. [4345

A S new, large TV console cabinet, manufacturers' surplus, suitable 9in to 15in tube, with shelf, £10.—Box 2018. [4491

WALNUT radiogram and television cabinets, inserts, samples, few only, stamp details.—Walters, 501, Hale End Rd., E.4. [4057

SERVICE sheets for sale, approx. £50, manufacturers and traders, first reasonable offer secures; owner going away.—Box 2057. [4415

RADIO and television cabinets made to individual requirements.—Sketch and details to Burman's, 64, Brighton Rd., London, E.5. [5020

WALNUT radiogram cabinets, £18, new 12in speakers, 45/-; stamp details.—Cabinetware, Summit Works, Hever St., Blackburn.

B.I.C.T.R.E. Journal, vols. I-VIII, exception vol. II; Nos. 1, 2, 3, bound; vol. IX unbound; lot bgns or offer.—Rogers Music, Dorchester. [4361

REFLEX corner cabinets, Briggs design, 1 R. spkr. B. cement lined, density factor, 5.—Particulars, Hammonds, 97, Queens Rd., Nuneaton. Tel. Nuneaton 3307. [4491

ALUMINIUM chassis and panels, any size manufactured to specification, holes punched for valveholders, etc., plain or cellulose finish.—E.A.D., 12, Broad Road, Willingdon, Sussex.

A HIGHLAND'S day is no trivial thing. Not—and stop freezing-up for all time. Even a woman can instal this device—you are then free from burst pipes, ruined ceilings, and plumber's bills.
If you have a.c. electricity 100 to 250 volts, just send us 39/6 and get the new safe anti-freeze system fitted to your water pipes.
NO tools required. Anyone can fix it.
MALDEN TRANSFORMER SUPPLIES, 200-202, Cambridge Rd., Norbiton, Surrey. [3036

P.X. exposure meter components.—Selenium light cell, 6/6; microamp meter movement, 10/6. Perspex case, 8/-; inverse polyvinol dials, 2/-; assembly instructions, 5/6; s.a.e. full details.
S.R. PRODUCTS, 78, Repton Rd., Bristol, 4.

TELEVISION mast sections, 8ft. 9in.×5in. dia., 3in. high, fitting sockets, steel tubular, reach any height, 15/6 ea., 6 or more 13/9 ea., all carr. paid.—Foundation Oil Co., Ltd., 5, Oxford Hill, Norwich. [4071

AERIAL masts, tubular, telescopic, tripod mounted, height approx. 35 feet, built of resin impregnated wood, £4/10 carriage paid.
ROTARY converters, 12 and 24v. d.c. supply, choke P.F. correction and mask transformer, unused, in metal box, £6/10 carriage paid.—Philpott, Fountain Square, Fenton, Stoke-on-Trent.

COPPER wire, enamelled, tinned, Lizt, cotton, silk covered, all gauges, BA screws, nuts, washers, soldering tags, eyelets, ebonite and laminated bakelite panels, tubes, coil formers, Tufnol pot headphone, flexes, etc. latest radio publication, 1/6; catalogue available; list s.a.e. trade supplied.—Post Radio Supplies, 33, Bourne Gardens, London, E.4. [1454

FLUORESCENT lighting, 80 watt tapped choke, circuit, 17/9; 80 watt kit of parts less tube and fitting, 55/9; 80 watt brkt. ballast wired with holders, 49/5; 80 watt slim quick-start ballast, 32/9; 40 Watt slab ballast bi-pins, glow starter, 24/9; 40 watt quick-start ballast bi-pins, 41/9; 40 watt white enamelled batten with tube, 82/6 plus 15/- crate deposit; feb line, twin 40watt slim ballasts with bi-pins and starter lamps, £20/-/-.
MALDEN TRANSFORMER SUPPLIES, 200-202, Cambridge Rd., Norbiton, Surrey. [10085

IF YOU REALLY WANT

NATURAL SOUND REPRODUCTION

YOU WILL COME EVENTUALLY TO A

BARKER LOUDSPEAKER

FOR THE SAME GOOD REASONS WHICH HAVE LED HUNDREDS TO A SIMILAR HAPPY SATISFYING AND LASTING CHOICE

There is a waiting list for both models at present and delivery takes two to three weeks. We regret this and are doing our best. The wise will act promptly in ordering now

WRITE FOR DETAILS TO

BCM/AADU
LONDON, W.C.1

WE DON'T

supply anything Ex-Government

ALL BRAND NEW GOODS

—fully guaranteed—

AUTOCHANGERS IN STOCK

GARRARD RC65A. A.C./D.C. Mixed Records. Standard lightweight Magnetic Head. **£20/15/-.**

GARRARD RC65A. A.C. Mixed Records. Standard lightweight Head, **£15/13/6.**

GARRARD RC70A. A.C. Non Mixed. Rim Drive. Standard Lightweight Head. **£10/9/1.**

E.M.I. MARCONI, A.C. Auto Changer, non mixed. Hi-Fi Head, complete with Transformer, **£10/10/8.**

COLLARO RC500. A.C. Auto Changer Non Mix. Crystal or Hi-Fi Head, **£10/15/0.**

CABINETS. Unpolished for all above changers. Motor Boards ready cut to fit place, **£3/10/-.**

MOTOR AND TURNTABLE, with magnetic Pick-up and Auto Stop. **COLLARO** A.C., **£9/13/6**; **GARRARD**, A.C./D.C., **£12/9/2.**

MOTOR AND TURNTABLE ONLY—COLLARO, Induction type, A.C., **£5/18/4.** A.C./D.C., **£9/5/6.**

TAYLOR TEST GEAR

The entire range by this famous maker is now available on HIRE PURCHASE. S.A.E. for Catalogue and Terms.

ALL AVO TEST GEAR NOW IN STOCK

AVO 7. Leather cases, **£2/2/6.**

We are the largest actual stockists of Avo Meters in England. S.A.E. for Catalogue and Price List.

All items can be supplied C.O.D. up to 15lb. in weight. Otherwise Cash with order please.

Special attention to Overseas Orders, which are free of Purchase Tax.

MODERN ELECTRICS LTD.
164, Charing Cross Road, London, W.C.2.
Telephone: Temple Bar 7587.

TRANSFORMERS & COILWINDERS

NEW AND REWINDS

All transformers Interleaved & Impregnated. Tested for (1) Shorted turns. (2) Insulation at 2 K.V. minimum. E.H.T. A SPECIALITY.

"R.E." MIDLAND SOUND & VISION COILS 14/6 SET. C.W.O.

J. E. THORNBER & SONS
3 DEAN AVE. MANCHESTER 16
CHO 3849 EST. 1925

WILCO ELECTRONICS

RACKS P.O. Standard 19in., with heavy angle iron base, 5ft. **60/-**; 6ft. **70/-**; 5ft. 6in. Lighter Type **50/-.**

OPERATORS DESKS. Standard 19in. Rack mounted 12in. deep, **15/-.**

PANELS for P.O. Racks. 5in., **3/9**; 10in., **7/6**; 18in., **12/6.**

POWER UNITS. 19in. Rack Mounting panel 19in. x 10½in., input 200-250 v., 50 cys., output 280-0-280 v. at 190 mA., 6.3 v. at 9A., 5 v. at 2A. Complete with choke, condensers, D.P. mains switch, indicator lamp, Bulgin connector, 5U4G Rect. and Cover, **£3/17/6.**

SPEAKERS P.M. 8in. Tannoy with Trans., **21/-.** 5in. Rola less Trans. in case, **17/6.**

Vibrators. Synch., 6 v. Mallory, **7/6** each. Non-synch., **5/6** each.

AMPLIFIERS. Push-pull. PX25s 15 watts output. Complete with Power Pack, less valves. Rack mounting, **£6**, carriage extra.

CO-AXIAL CABLE for Television down leads, 75 ohms, **10½d.** per yard.

RECEIVERS TYPE WS737. 1-10 Mcs complete with 5 valves, less power pack, **£3** each.

MICROAMMETER—F.S.D. 25 microamps, scaled 0-500, 2½in., **57/6.**

VOLTMETERS. 0-300 A.C. M.I. 2½in. Flush, **17/6** each., 3½in., **22/6** each.

204 LOWER ADDISCOMBE ROAD, CROYDON ADD. 2027

ENGRAVING, amateurs and trade could take the opportunity of engraving problems in the future by getting in touch with A. G. Engraving, 19a, Windmill Rd., London, S.W.18. Brass, bronze, erinoid, perspex, dials; one knob or repetition equally entertained. [0034

3/6—For this modest sum we supply you with full constructional details for building our latest 10watt quality amplifier with variable negative feed-back; these constructional sheets are simplified so that the most inexperienced person may build and obtain first-class results. Complete Home Constructor's Handbook with circuit of this and many other sets, 1/- extra.—Suparolls, Mail Order Office, 98, Greenway Ave., London, E.17. [0055

SITUATIONS VACANT

Vacancies advertised are restricted to persons or employments excepted from the provisions of the Control of Engagements Order, 1947.

GOVERNMENT OF IRAQ.

FIRST assistant radio engineer required by Basrah Port Directorate for one year in first instance. Salary I.D.60 rising to I.D.80 a month, Gulf allowance I.D. 24.5 a month, high cost of living allowance of between I.D.8 and I.D.14 a month according to salary and dependants (Iraqi Dinar 1=£1). Provident fund, free passages. Candidates must (a) hold P.M.G. 1st class certificate in wireless telegraphy and (b) be A.M.Brit.I.R.E., or hold City and Guilds Final Certificate in Radio Communication; they must have had practical experience of commercial wireless transmitters and receivers and electrical equipment and preferably some experience at a large civil airport.—Apply at once by letter, stating age, whether married or single, and full particulars of qualifications and experience, and mentioning this paper, to the Crown Agents for the Colonies, 4, Millbank, London, S.W.1, quoting M/N/25005/3B) on both letter and envelope. The Crown Agents cannot undertake to acknowledge all applications and will communicate only with applicants selected for further consideration. [4693

CROWN Agents for the Colonies.

RADIO Telegraph Inspector required by Nigeria Government Posts and Telegraphs Department for one tour of 18 to 24 months, salary £850 a year (including expatriation pay); outfit allowance £60; free passages; the duties of the post are those of a construction foreman engaged on the installation of radio diffusion or relay systems including fitting central receiving stations with diversity reception receivers, aerial arrays, etc., and subscribers lines and apparatus; candidates should have had experience with a company operating radio relay services; apply at once by letter, stating age, whether married or single, and full particulars of qualifications and experience and mentioning this paper to the Crown Agents for the Colonies, 4, Millbank, London, S.W.1, quoting M/N/24719 (3B) on both letter and envelope, the Crown Agents cannot undertake to acknowledge all applications and will communicate only with applicants selected for further consideration. [4506

BRITISH Electricity Authority, Eastern Division.

A GENERAL assistant engineer is required in the Communications Section of the Technical Department at Divisional Headquarters in North London. The work will include the maintenance of telephone type switchboards and electronic equipment. Applicants should be graduate members of the Institution of Electrical Engineers or have satisfactory academic qualifications, and should have had considerable experience in the adjustment of telephone relays and switches.

THE salary range for the position is in accordance with the Divisional Engineering Staff Salary Schedule (£417/8 to £549/16 per annum which includes London Allowance).

THE appointment will be superannuable in accordance with the British Electricity Authority and Area Boards Superannuation Scheme.

APPLICATIONS, stating age, experience and present position should be sent to arrive not later than 11th March, 1950, in envelopes endorsed "General Assistant Engineer (Technical Department)," to the Divisional Controller, Eastern Division, British Electricity Authority, Northmet House, Southgate, N.14.

W. N. C. CLINCH, Controller, Northmet House, Southgate, N.14. [4838

SERVICE department of large radio manufacturers in North London district has vacancies for:

(a) correspondence clerk.
(b) radio engineers.
(c) receiving clerk.
(d) office junior (male or female) and workshop junior.

APPLICANTS for (a) must have at least Secondary School education and hold Matriculation or School Certificate, be capable of writing good business letters, and have adequate training in radio theory and practice.

IN (b) educational standards and technical training as above.

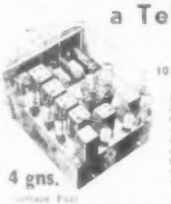
FOR (c) qualifications should include education to School Certificate standard, and some practical knowledge of radio.

THE vacancies under (d) offer opportunities for boy or girl with good education, capable of accurate and conscientious work, and anxious to learn and progress. Some interest in radio would be an advantage.

APPLICATIONS in own handwriting, must include full particulars of education, qualifications, technical and commercial experience, age and salary required.—Box 7[illegible], c/o Wireless World, 2, Dorset Sq., London, W.1. [illegible]

EXPERIENCED Electrical Engineer required for wiring, assembling amplifiers.—Please reply Box 2047. [4565

Thinking of building a Television Set?



10 VALVE 1½ METRE SUPER-HET

Ideal for conversion into Television Receivers. I.F. 12 Mcgs. Band width 4 megs. Co-axial input and output sockets. 10 Mazda Mains type VR65 (SP61) valves, 6.3 volt filaments.

4 gns. Carriage Paid

ASH MASTS

30-feet Masts. 10-section best selected Ash. Socketed ends complete with guy ropes, picket posts, fixing instructions, etc. In manufacturer's sealed CASES.

£2/15/- *plus 5/- carriage*

Brand New

Westinghouse

45-ft. 10-Sectional

2" DURAL MASTS

Complete with six guy ropes, picket posts, packed in canvas bag.

EACH **£4/10/-** *plus 6/- carriage*

or two of above in wooden transit case

£7/10/- *plus 12/6 carriage*

Dept. W **WIRELESS INSTRUMENTS (Leeds) Ltd**
54-56 The Headrow, Leeds Tel. 22262.

Our 1950 fully Illustrated Catalogue is now Available 3d. Post Free

BERRY'S (SHORT WAVE) LTD

25, HIGH HOLBORN, LONDON, W.C.1

NEW Armstrong SERVICE IN THE MIDLANDS

You can now see and hear Armstrong television and radio in Birmingham! Come and see for yourself just why Armstrong chassis are the choice of the connoisseur.

Number 49 and 50 buses from city centre pass the door. We are open 9 to 6 all the week, including Saturdays, or by appointment at any time.

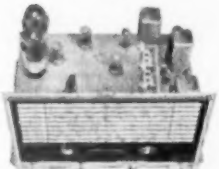
THE HAYES COMPANY

1 ALCESTER ROAD
MOSELEY BIRMINGHAM 13

BAND SPREAD

by Armstrong

the NEW EXP 119



This model has been produced after exhaustive investigation into the requirements of Overseas Listeners. Ease of operation on the short-wave band-high sensitivity and quality output have all been studied and incorporated in the EXP 119.

BRIEF SPECIFICATION

1. Designed specifically for the Overseas Listener.
2. 9 wave ranges. (6 bandspread and 3 general coverage) 11-576 metres.
3. High slope pentode R.F. stage.
4. 2 stages of I.F. amplification.
5. Variable selectivity.
6. Automatic noise limiter.
7. 10 watts push pull output.
8. Separate A.C. power pack to facilitate operation from a vibrator if required.
9. 11 valve circuit (including cathode-ray tuning indicator).

A few of these models are now available for the home market price £36 plus P.T.

Write now for fullest information

Armstrong

THE CHASSIS PEOPLE

Armstrong Wireless & Television Co. Ltd.
Warlters Road, Holloway, London, N.7.
Telephone: NORth 3213

SOLE BIRMINGHAM AGENT:
Hayes Company,
1 Alcester Rd., Moseley, Birmingham, 13

SOLE AGENTS FOR
KENYA, UGANDA, TANGANYIKA & ZANZIBAR:
Messrs. Jennings & Fox (Mombasa) Ltd
Kilindini Road, P.O. Box 56, Mombasa
Kenya.

THE UNITED LEEDS HOSPITALS

THE RADIOTHERAPY CENTRE at Leeds. A TECHNICIAN with electronics experience is required to assist in the construction and use of apparatus for the measurement of the radioactive content of the human body. The work is being carried out on behalf of the Medical Research Council, and the appointment will be temporary in the first place. Salary £350 p.a.; application forms obtainable on written request to the undersigned.
F. CLAYTON FRYERS, Secretary to the Board. [4903

TELEVISION Testers required by North London manufacturers.—Please give full information regarding past experience, etc., to Box 2061. [4903

THE Ministry of Supply invite applications for the following appointment in the Division of Atomic Energy (Production), Risley, nr. Warrington, Lancs.
DEPUTY Chief Instrument Engineer to be responsible for the provision and adaptation of instruments for the division's factories. The range of instruments to be used will include all standard forms of control and recording devices for pressure, temperature, and flow of liquids and gases through pipes, and instruments for measuring and controlling radio-activity.
CANDIDATES must either hold an engineering degree of a recognised university, or be corporate members of one of the Institutions of Civil, Mechanical or Electrical Engineers. They must have served an engineering apprenticeship; only very exceptional experience in the duties specified above will be considered in lieu of these qualifications.
SALARY will be assessed according to experience and qualifications on the inclusive range £897 to £1,300 per annum.
CANDIDATES will normally be confined to natural born British subjects, born within the United Kingdom or one of the self-governing Dominions, of parents similarly born.
APPLICATIONS giving full particulars of qualifications and experience should be sent to the Administrative Branch, Ministry of Supply, Division of Atomic Energy (Production), Risley, nr. Warrington, Lancs. [4912

RADIO and television service engineer, part time considered, only first-class technicians need apply, write fully to—Mr. Standing, 16, Southside, London, N.7. [4904

MINISTRY OF SUPPLY invites applications from physicists for following posts in Scientific Officer Class at Research and Development Establishment near London:—
1. ELECTRONIC physicist for work on application of electronic methods to photography of detonation phenomena; experience high-speed photography desirable.
2. CLASSICAL physicist for study of experimental results of work on detonation waves.
3. THEORETICAL physicist for work on effect of blast on structures; knowledge of fluid mechanics and strength of structures desirable.
4. PHYSICIST with wide and varied experimental experience; electronics knowledge an advantage.
5. GENERAL physicist with maths for experimental work on electrical and optical investigations and mathematical analysis of results.
6. PHYSICIST with mathematical ability for work on aerials, U.H.F. experience desirable.
7. PHYSICIST and electronic engineer for work on electro-optical systems.
8. PHYSICIST with maths to plan and organise experimental work with small team; previous research experience desirable.
ALL candidates must have an honours degree or equivalent in physics, and for the S.S.O. grade have at least 2 years' post-graduate research experience, salaries according to age qualifications and experience within ranges—
SENIOR scientific officer (minimum age 26) £670–£860, scientific officer £450–£620.
RATES for women somewhat lower, posts are unestablished but carry F.S.S.U. benefits.
APPLICATION forms obtainable from Technical and Scientific Register (K), York House, Kingsway, W.C.2 quoting A21/50/A; closing date 15th March, 1950. [4921

THE EDISON SWAN ELECTRIC Co. Ltd., Ediswan Works, Brimsdown, Enfield, Middlesex, require qualified engineers and physicists for the following appointments:
(A) CIRCUIT development engineers, for work in connection with television and pulse circuits.
(B) RADIO valve and cathode ray tube development engineers.
BOTH classes of vacancies include senior posts for men with extensive experience in responsible positions, other vacancies for men whose experience is less extensive, have a salary range of £400–£600 per annum dependent on age and qualifications. Applications for all vacancies should be as much information as possible, should be made to the Personnel Supt., at the above address. [4909

RADIO mechanic required for servicing in Kensington area; must have driving licence. Commencing £6 weekly.—Write or call General Acoustics, Ltd., 8–10 Douglas St., Victoria, S.W.1. [4906

FEMALE charge hands required for radio components in West London area, only applications will be considered from people who have had previous experience of this type of work.—Box 4102. [4102

ENERGETIC progress man required for production chasing department; experience essential in radio and television.—Apply in person to Sonophone-Baird, Ltd., Lancaster Rd., Wembley, Middx. [4427

TELEVISION test and trouble shooters required for Birmingham television factory; write in confidence stating age, previous experience and salary required; own staff advised of this advt.—Box 2064. [4908

MAINS TRANSFORMERS

(Postage Extra)

As supplied to the Ministry of Supply, B.B.C., Generation Authorities, etc.
Interleaved and interrupted. Screened primaries tapped 200/250 v.

DROP THROUGH TYPE. TOP SHROUD.

(a) 250–0–250 v. 60 mA., 4 v. 3 a., 4 v. 1 a. 15/6
(b) 350–0–350 v. 80 mA., 4 v. 4 a., 4 v. 1 a. 15/6
Following types have Universal L.T. windings 4.5–4 v. 4 a. C.T., 5–4 v. 3 a.
(c) 350–0–350 v. 80 mA. 17/6
(d) 300–0–300 v. 80 mA. 17/6
(e) 350–0–350 v. 80 mA. 17/6
(f) 350–0–350 v. 100 mA. 19/6
(g) 380–0–380 v. 100 mA. 19/6
(h) 350–0–350 v. 150 mA. 19/6

FULLY SHROUDED UPRIGHT TYPES.

(1) 350–0–350 v. 150 mA., 5.3 v. 3 a., 4 v. 2 a. C.T., 5–4 v. 3 a. 39/-
(2) 425–0–425 v. 150 mA., 5.3 v. 4 a. C.T., 5.3 v. 4 a. C.T., 5–4 v. 3 a. 42/6
(3) 425–0–425 v. 200 mA., 4 v. 5 a. C.T., 4 v. 4 a. C.T., 4 v. 4 a. 44/6
(4) 475–0–475 v. 200 mA., 5.3 v. 4 a. C.T., 4 v. 4 a. C.T., 4 v. 4 a. C.T., 4 v. 3 a. 47/-
Note.—Model (4) above is suitable for Williamson Amplifier.

WILLIAMSON OUTPUT TRANSFORMER.

Built to Author's specification. LT52 standard. £3 12 6

WILLIAMSON SMOOTHING CHOKES.

Choke No. 1 £1 2 6. Choke No. 2 12/6

FEEDER UNITS.

High-class Feeder units with R.F. stage, switched for six sockets. Other types. Completely aligned.
MODEL A. Covers 16/50, 190/550 and 200/2,000 metres. Price, including P. Tax £10 8 6
MODEL B DE LUXE. Covers 40/140, 190/550, 800/2,000 metres and six ranges of band spread. Price, incl. P. Tax £18 7 6
MODEL E. As Model A, but with Variable Selectivity and adjustable impedance detector. Price, incl. P. Tax £10 15 0

"VIEW MASTER" TELEVISION RECEIVER.

Designed in conjunction with prominent British Radio Manufacturers using new components—not surplus. CONSTRUCTOR'S ENVELOPE, containing full instructions, layouts, diagrams, etc., 5/4 post free.

W.B. Chassis and Speaker, etc.	£8 5 0
T.C.C. Condensers	£0 15 0
Westinghouse Rectifiers	£3 2 6
Morganite Resistor Kit	£1 6 9
Pioneer Transformers, Focus Coils, etc.	£5 12 6
Osborn Wire Wound Potentiometers	19 3
Bulgin Panels and Switches	12 6
Wearite Coils and Choke	£1 2 0

B.V.A. AND TUNGSRAM VALVES.

Over 200 different types in stock, including difficult types. Quote types. B.O.T. prices. Send for the valve you urgently require. C.O.D.

POLISHED ALUMINIUM CHASSIS, 16 S.W.G., 4 SIDES, 3 in. DEEP.

10in. × 6in., 10in. × 8in., 8/6. 10in. × 9in., 10/6.
14in. × 9in., 16in. × 9in., 11/6. 20in. × 9in., 12/6.

EDDYSTONE SHORT-WAVE COMPONENTS.

Full range stocked. Eddystone Illustrated catalogue, 6d.

HIGH FIDELITY LOUDSPEAKERS.

Goodmans 12/15in. 12in. P.M. £6 15 0
Goodmans 8/10in. 10in. P.M., Twin Cone £5 8 0

INSTRUMENT WIRES.

Comprehensive range in enamelled, cotton and silk covered copper wires from 16 S.W.G. to 40 S.W.G.

EX-GOVT. SURPLUS.

A great range of equipment at bargain prices.
A.T.C. Rail Microphones. Lift spares £37 £4 15 0

TRANSMITTING VALVES.

807, 6/-; 866, 25/-; 813, 36/6; 814, 9/6.

SEND NOW 5d. in stamps for 52-PAGE CATALOGUE.

Terms C.W.O. or C.O.D.

COULPHONE RADIO

"The Return of Post Mail Order Service"

53, BURSCOUGH STREET, ORMSKIRK, LANCS.

Phone 987

You can GET it, and quickly from:—

WIRELESS SUPPLIES UNLIMITED

264-266 Old Christchurch Road, Bournemouth, Hants.

Send your list of requirements for instant attention. Regret no Catalogue at present, but we DO have the merchandise.

TELEVISION CONSTRUCTORS!

E.E. Television Demonstrated Daily

MIDLAND CONSTRUCTORS ETC.

ARE INVITED TO SEND FOR OUR COMPLETE COMPONENT LIST AND TAKE ADVANTAGE OF OUR

PROMPT POSTAL SERVICE

J. T. FILMER MAYPOLE ESTATE, BEXLEY, KENT. Tel. Bexleyheath 7267

100 kcs. QUARTZ CRYSTAL UNIT *Type* Q5/100

for Secondary Frequency Standards

★ Accuracy better than 0.01% ★ Temperature coefficient 2 parts in a million per degree Centigrade temperature change ★ Gold electrodes applied by cathodic sputtering direct to the faces of the crystal, giving permanence of calibration. ★ Simple single valve circuit gives strong harmonics at 100 kcs. intervals up to 20 Mcs. ★ Octal based mount of compact dimensions. PRICE 45/- *Post Free*

Full details of the Q5/100 including circuit are contained in our leaflet Q1. Send stamp today for your copy.

THE QUARTZ CRYSTAL Co., Ltd.

63-71 Kingston Road, NEW MALDEN, SURREY

Telephone: MALden 0334

TWO first-class Radio Engineers required, knowledge of television an advantage.—Write, giving full particulars, experience, etc., to Wilson Peck, Ltd., Pargate, Sheffield, 1.

FERRANTI, Ltd. have vacancies in their radio works, Moston, Manchester, for physicists and engineers for research and development work in vacuum and gas-filled electronic devices as follows:—

(a) SENIOR development engineers, qualifications include a good degree in physics or electrical engineering and extensive experience in a responsible capacity in the electronics field.

(b) DEVELOPMENT engineers, qualifications include a good degree in physics or electrical engineering or suitable extensive experience in electronics.

SALARY on a liberal basis, according to qualifications and experience, the company has a staff pension scheme.

APPLICATION forms from the Staff Manager, Ferranti, Ltd., Hollinwood, Lancs. [4306

DRAUGHTSMEN, seniors and juniors required in London district; experience in light mechanical design, knowledge of workshop practice an advantage; state age, experience and salary required to Box 2357. [4296

RADIO service mechanic required for large company, main dealers in S.W. London; write stating age, experience and salary required; highest references essential.—Box 2033, Offers, 44, Hertford St., London, W.1. [4274

RADIO Engineer required for factory laboratory making test equipment, knowledge of radio fundamental and some experience in valve radio test equipment, familiarity with machine tool an advantage.—Apply Box 2024.

TELEVISION RADIO service engineer, fully experienced and able to drive, permanent position with excellent opportunities; full particulars and salary required (Ref. W.2).—Elliott, 102, Hawardgate, Welwyn Garden City, Herts.

TELEVISION manufacturers require service engineers for the Manchester area, applicant must be single and have, in each, sound experience in the servicing of radio; must be prepared to work in London area before taking up duties in Manchester.—Box 2030. [4265

REQUIRED by well-known Croydon manufacturers, adaptable young man with very sound knowledge of radio, able to deal with technical correspondence, sales, etc.; a good opening for a keen type; write, stating age, experience and salary required.—Box 2020. [4264

RADAR Mechanics.—Competent mechanics required with experience in radar installation and setting, marine and land installations; a permanent job with excellent prospects for the right man.—Write, stating age, qualifications and experience to Box 2047. [4241

REPRESENTATIVE having really good connections with and at present selling to radio and electrical and/or motor traders, required by old-established electrical manufacturer to offer attractive non-competitive lines on liberal commission basis.—Box 1446. [3025

PRODUCTION Manager.—A well-paid and permanent situation is offered to a man of first-class experience and qualifications as production manager for radio factory in South Wales.—Write, giving full details of past experience and salary required, Box 2042. [4261

RADIO engineers required for work on industrial electronic equipment in expanding organisation, preference given to man with production experience, good opportunity for an ambitious man.—Write, stating age, qualifications, experience and salary required to Box 2032. [4216

ADVERTISEMENT representative for radio publication and to assist in office duties in a London agency; excellent opportunity for man with previous experience in agency work; write giving age, experience and salary desired to—Box 6, Parts, 121, Kingsway, London, W.C.2.

CHIEF engineer required to take charge of small laboratory at radio manufacturers in N.E. London; must have good technical ability in design of R.F. test equipment and radio components.—Write, giving full particulars of qualifications and experience, stating age and salary required, Box 1990. [4127

LABORATORY technician required for the construction of electronic apparatus to be used for research purposes; starting salary dependent on qualifications and practical experience.—Apply the Head of the Electrical Engineering Department, City & Guilds College, Exhibition Rd., S.W.7. [4202

JUNIOR engineer required for testing and calibrating high grade audio frequency equipment, previous experience essential and education up to Inter. B.Sc. or equivalent.—Apply giving age, full details of education, experience and salary required to R.M.I., Studios, Ltd., 5, Abney Hill, Stanmore, Wood, N.W.7. [4164

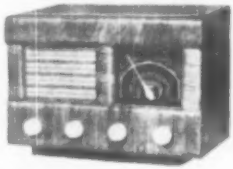
FOREMAN required for assembly shop of radio manufacturers situated in West London area; only people who have had previous experience in controlling men and assembly of radio and television receivers and allied products need apply, when writing please give full details of previous experience and state salary required. Box 2014.

INSPECTOR, there is opening there is usually a job for the right man at Sound Sales, Ltd.; applicants, who should be of British origin, should state age, details of experience, salary or wage required, by letter; testimonials should not be forwarded with inquiry; previous factory experience essential.

THE Managing Director, Sound Sales, Ltd., West St., Dereham, Norfolk. [4204

ENGLISH ELECTRIC require for their Nelson Research Laboratories, Stafford, an experienced contract engineer to co-ordinate and plan work going into the laboratories and workshops.—Write, giving full details of previous experience, quoting reference 355, to Central Personnel Services, English Electric Co., Ltd., 24, Gillingham St., Westminster, S.W.1. [4013

CABINETS AND COMPONENTS



Receiver cabinets as illustrated. Beautiful walnut veneer. Size (12" × 8½" × 7½" deep. 35/-. *We can construct any type or quantity of cabinets to specification. Send full details.*

All components to construct a T.R.F. or Superhet Receiver in above cabinet are available. Lists on request.

4 Watt A.C. Quality Amplifier, with negative feedback and separate bass and treble controls, from £5. 15s. 0d. 5 Watt Universal similar to above from £3.15s.6d. 12 Watt Universal from £8. 5s. 0d. Full details on request.

LEWIS RADIO CO. (Dept. W.3) 327, High Road, Wood Green LONDON, N.22 'Phone: BOWes Park 5997

TESTOSCOPE *Mains Tester*

For high & low voltage testing—:

Up to 250/350 volts A.C. or D.C. Write for interesting leaflet to:

RUNBAKEN · MANCHESTER 1

SUPACOILS

Have pleasure in announcing that they can now supply all the components for the famous

VIEWMASTER

THE TELEVISOR THAT YOU CAN BUILD FROM STANDARD COMPONENTS.

FAILURE IS IMPOSSIBLE!

Viewmaster Envelope of Instructions with 8 detailed full size drawings and constructional details for building this Modern Televisor, together with complete list of Television Components 5/-

Kits of Components by the recommended manufacturers are available as follows:—
Wholesley Electrical, £6 5/-. Plessey, £5 12 6. Bulgin, 12 6. Westinghouse, £3 2 6. Wright and Weaire, £1 2/-. Colvern, 19 3. Belling & Lee, 7 6. G.E.C., 2 9. Morganite, £1 15 9. T.C.C., £6 15/-. Valves as specified. Stamp for list.

We cater exclusively for Mail Order Customers and you can trust our packing and despatch department to see that your orders are dealt with promptly and reach you in perfect condition, whatever the distance.

SUPACOILS (Mail Order Office) 98, Greenway Avenue, London, E.17

When Quality Counts . . . .

. . . the *HOMELAB* Signal Generator is a wise choice. But there is a snag—we cannot give immediate delivery. The fact is that the large demand for this instrument has, until recently, exceeded our manufacturing capacity. Some of our customers have had to wait longer than was anticipated, but we have now obtained additional premises for the production of the *HOMELAB* and are able to make lots more of them. During the next few weeks we will be able to get right up to date with orders. We offer our apologies to those who have patiently awaited delivery—but we gather from the letters we receive that the *HOMELAB* is well worth waiting for.

May we remind you that the *HOMELAB* Signal Generator has the following features :

- 100KCS. to 130 MCS.
- 30 per cent. MODULATION AT 400~ or
- UNMODULATED CARRIER
- PROVISION FOR EXTERNAL MODULATION
- OUTPUT IMPEDANCE 10Ω
- LOW EXTERNAL FIELD
- BUFFER STAGE
- VARIABLE 400~ OUTPUT
- ACCURACY OF CALIBRATION ±1 per cent.
- A.C. MAINS OPERATION ONLY.

PRICE £6 : 11 : 0 plus 5/- for packing, etc.

Please send S.A.E. for full technical details and enclose P.O. for 2/6 if circuit diagram required. The *HOMELAB* Signal Generator can be seen at our new showrooms—the address is HOME-LAB INSTRUMENTS, 374, High Road, London, E.11—but orders can only be accepted by post and these, together with all enquiries should be addressed to :—

HELY-MANN
ELECTRONICS LABORATORIES
116, GROVE RD., LONDON, E.17.

A FEW unusual opportunities occur in the laboratories of Ferguson Radio Corporation, Ltd., for senior and junior development engineers, for work on domestic radio and television receivers and electronic equipment for Government services; applicants must possess a University degree, preferably in engineering or equivalent qualifications.
DESIGNER-DRAUGHTSMEN are also required for similar work; previous experience essential; excellent prospects for keen, enthusiastic man.—Write with full details to Chief Engineer, Ferguson Radio Corporation, Ltd., Cambridge Rd., Enfield. [5007

PYE, Ltd., Cambridge, applications are invited from experienced television engineers for posts in the field demonstration section, the function of which is to exhibit television transmission equipment both in the U.K. and abroad; applicants are requested to write giving full details of qualifications and experience to the Personnel Manager, Pye, Ltd., Cambridge.

APPLICATIONS are invited from senior and junior graduates in physics, mathematics and electrical and mechanical engineering by the research laboratories of The General Electric Co., Ltd., North Wembley, Middx.—Details of openings will be sent to all suitable applicants sending particulars of age, academic qualifications and experience to the Personnel Officer.

BRITISH TELECOMMUNICATIONS RESEARCH, Ltd., Taplow Court, Taplow, Bucks, require mechanical engineering draughtsmen preferably with experience on radar and radio, for interesting and varied work; also draughtsmen for detail on telecommunications equipment; good working conditions, canteen facilities, etc.—Apply Chief Draughtsman. [5030

MECHANICAL draughtsman required, preferably with experience in the layout and detailing of radar equipment, electronic apparatus and small mechanisms; applicants must be quick and accurate and able to prepare full manufacturing drawings, working on own initiative with a minimum of supervision.—Apply Personnel Manager, F. K. Cole, Ltd., Ekco Works, Malmesbury, Wilts.

TECHNICIAN required to service 16mm. film projectors (sound and silent) and other visual aids equipment; preference will be given to applicants who are also experienced radio mechanics; ability to drive service van essential; the post will be permanent and superannuable after two years.—Full details of age, experience and wage required, to Box W.W., c/o Barlett's Publicity, 51, Museum St., W.C.1. [4980

LARGE manufacturer of radio and television in London area is increasing productive capacity and for this purpose requires senior foreman with experience of the control of female labour engaged on radio production, male and female charge hands with experience in the tuition of female labour for soldering and assembly operations.—Kindly state full details of experience, age and salary required, to Box 2011. [4914

SENIOR and junior development engineers and draughtsmen for radio, radar, electronics, etc.; service engineers (radio, television (London and Birmingham), radar, electronics, wiremen (skilled and semi-skilled), radio, radar, etc., H.F. repairers, testers, inspectors, assemblers for radio, television, radar, P.A.; numerous other senior and junior positions vacant.—Technical Employment Agency, 179, Clapham Rd., S.W.9 (Brixton 5677). [4917

BELLING & LEE, Ltd., Cambridge Arterial Rd., Enfield, require the services of a qualified engineer-physicist, with a wide experience of aerial research, to develop television and V.H.F. receiving aerials of all types; an inventive flair is highly desirable; salary will be commensurate with qualifications and experience.—Applications, stating age, experience and salary required, should be addressed to the Secretary and will be regarded as confidential. [4926

PRODUCTION manager required by leading hearing aid makers; recent experience of modern production methods in similar position essential; must have good mechanical knowledge and ability to handle all production functions; work will be in East London for some months, later transferring to new factory at High Wycombe; give full details of past experience and salary required.—Write Box M.1002, Hudsons, Salisbury Square, London, E.C.4. [4978

AN assistant to the chief development engineer is required by a large company manufacturing radio components and allied products; applicants must have technical education to B.Sc. in electrical engineering or physics and must have experience of development work in the radio field; a permanent and progressive position will be offered to an applicant with these qualifications and between the age of 30 and 35 years; kindly state fullest details in strict confidence to Box 2061. [4976

VACANCIES exist in the Nelson research laboratories of the English Electric Co., Ltd., Stafford for senior and junior physicists and engineers for work in the vacuum physics laboratory; a degree in physics or engineering essential, and preference will be given to men experienced in electron optics and vacuum techniques.—Write, giving full details, quoting Ref. N6 to Central Personnel Services, English Electric Co., Ltd., 24, Gillingham Street, Westminster, S.W.1. [4954

A company engaged upon the design and development of electronic equipment requires a Senior Engineer; applicant should have an Honours degree in Engineering and be an associate member of the Institute of Electrical Engineers; experience must include the design and development of electronic equipment, preferably for industrial use; salary up to £900 per annum will be paid to the successful applicant.—Applications should give full details, including salary required, to Box 2038. [4956

L·R·S

FOR
PROMPT & EFFICIENT SERVICE
CASH OR EASY TERMS

When you purchase on L.R.S. Convenient Terms Formalities are reduced to a Minimum and you deal direct with us from beginning to end.

ARMSTRONG
ALL WAVE CHASSIS
(incl. speaker and output transformer)

Model EXP/83/3. Cash price **£18 . 17 . 1** or £4 . 12 . 0 with order and 12 monthly instalments of 26/-.

Model RF103/3. Cash price **£25 . 12 . 6** or £5 . 10 . 0 with order and 11 monthly payments of £2 . 0 . 0.

All other Armstrong Chassis are available on similar terms.

Also available on Easy Terms

LEAK TUNERS and AMPLIFIERS
★
GRAMPIAN SOUND EQUIPMENT
★
SOUND SALES AMPLIFIERS and TUNERS
★
PARTRIDGE TRANSFORMERS and CHOKES
★
A.C. BARKER'S LOUDSPEAKERS
★
GOODMAN'S LOUDSPEAKERS
Axiom 12 and 22 also 12" Standard Unit
★
HARTLEY-TURNER LOUDSPEAKERS
★
WHARFEDALE LOUDSPEAKERS
★
ATLAS BATTERY CHARGERS

COLLARO
RADIOGRAM UNITS
A.C. 505 M.B. Cash price **£7 . 6 . 3** or £2 . 2 . 0 with order and six monthly instalments of £1 . 0 . 0.

RECORD CHANGERS
R.C. 590 with crystal pick-up. Cash **£10 . 15 . 0** or £3 . 12 . 0 with order and eight monthly instalments of £1 . 0 . 0.

All other Collaro R.C. units and Record changers available on similar terms.

and most of the other High-Grade Equipment advertised in "Wireless World"

also

REMINGTON-RAND Foursome Electric Shaver (one of the very best shavers made). Cash price **£8 . 1 . 0** or £2 . 0 . 0 with order and seven monthly instalments of £1 . 0 . 0.

All prices include carriage and packing

Please let us know your Radio requirements (enclosing 2½d. stamp) and we shall be pleased to quote.

Personal attention to all enquiries

THE LONDON RADIO SUPPLY CO.
Est. 1925
BALCOMBE, SUSSEX

HILL & CHURCHILL LTD.
BOOKSELLERS
SWANAGE, DORSET
Available from stock

"Television"—Zworykin & Morton	42/-
"Hyper and Ultrahigh Frequency Engineering"—Sarbacher & Edson	35/-
"Principles of Radio Engineering"—Glasgow	30/-
"Radio Receiver Design"—Sturley—2 Vols.—each	28/-
"Electric Circuits and Wave Filters"—Starr	25/-
"Theory of A.C. Current Wave Forms"—Kemp	17/6
"The Practical Radio Reference Book"—Norris	8/6
"Radio-frequency Measurements by Bridge and Resonance Methods"—Hartshorn	21/-

Postage Extra
CATALOGUE ON APPLICATION

APPLICATIONS are invited for assistant electrical engineers to be engaged on testing or design in the research laboratories of a telecommunication cable factory in S.E. London; previous experience in telecommunications is a recommendation, but not essential, as part-time training at firm's expense will be considered; suitable ages 19-25; salary according to age and experience.—Applications giving training and experience should be addressed to Box 2055.

NORTH West Public Company requires services of technician for development of television aerial equipment, cabling, moulded electrical products; first-class man of high calibre capable of directing the development of new products, market research and able to deal with production problems; man with drive and initiative coupled with good technical knowledge essential; possibility later of position on board of directors for right man; age between 30-45.—Full particulars and salary required to Box 2040. Endorse application "Technician." [4940

MURPHY RADIO, Ltd., are expanding their Electrical Design Laboratory and urgently require the services of Television and Radio Engineers having good academic qualifications (Hons. degree in Physics or Electrical Engineering) and experience in industrial design laboratories. There are also openings for graduates trained in these branches, but without industrial experience.—Applications, giving full particulars of training and experience should be forwarded to Personnel Department, Murphy Radio, Ltd., Welwyn Garden City, Herts. [4942

ASSISTANT to director North West public company manufacturing plastic mouldings, cables, television parts, aerial equipment; first-class man wanted, must be qualified mechanical-electrical technician and have first-class administrative ability; able to deal with market research, sales depots and have good knowledge of production and factory problems; only first-class man of high ability need apply; possibility later of promotion to board of directors.—Full particulars and salary required to Box 2041. Endorse application "Assistant to Director."

FERRANTI, Ltd., invite applications from energetic electronic engineers with a sound electro-mechanical background to take charge of a section engaged in the development of means for the magnetic storage of digital information. Qualifications include a good degree in physics or electrical engineering, but originality of thought and ability to lead a development section are of primary importance; the position is of great interest to any keen engineer convinced of the future of electronic digital computation; salary will be in the range of £600 to £1,000 per annum. APPLICATION forms from The Staff Manager, Ferranti, Ltd., Hollinwood, Lancs. [4915

CHIEF Radar and Radio Engineer required to take charge of a department engaged in the development and design of commercial and service pulse and C.W. high frequency equipments; applicants should possess high technical qualifications allied with administrative experience, and should give full particulars of their training and experience when replying; replies, which should be marked "Personal," and addressed to the Electrical Engineering Director, Metropolitan-Vickers Electrical Company, Ltd., Trafford Park, Manchester 17, will be treated in the strictest confidence. [4907

ELECTRICAL engineers are required by the Nelson Research Laboratories, Stafford. Applicants should possess a degree in Electrical Engineering and have experience in the operation and maintenance of heavy electrical plant. Duties will include short circuit testing of switchgear, and applicants must have an interest in development work. Successful married applicants with a family will be considered for a house after probationary period.—Write, giving full details, quoting ref. 798, to Central Personnel Services, English Electric Company, Ltd., 24, Gillingham St., London, S.W.1. [4965

DECCA RADAR.—The Decca Navigator Company are engaged on a considerable programme of radar research, development, production, and world-wide sales and servicing; the programme creates a steady demand for well qualified radar engineers and others with specialised experience in this field and offers men with ability, energy and initiative excellent opportunities both at home and abroad at salaries ranging from £500-£1,000 per annum; applications are invited for both immediate and future posts; all applications will be treated as strictly confidential.—Write only in first instance to Ref. EP, The Decca Navigator Co., Ltd., 1-3, Brixton Rd., London, S.W.9. [4978

B.B.C. invites applications for two posts in the Recording Section of Research Department based initially at Balham, London, and later at Kingswood, Surrey. One of the posts is in a grade with annual increments of £30 and a maximum salary of £900 per annum and the other in a grade with annual increments of £30 and a maximum salary of £680 per annum. Applicants must possess a degree or equivalent qualification in electrical engineering. The successful applicants will be employed on research and development work on all aspects of sound recording and familiarity with low frequency circuit technique is therefore essential. A knowledge of music would be an advantage. For the more senior post applicants must also be familiar with the design of light electrical mechanical equipment and have the ability to organise development work in the drawing office and workshop. These qualifications are desirable to a lesser degree for the less senior post.—Applications stating age, qualifications, details of past and present employment, should reach the Engineering Establishment Officer, Broadcasting House, London, W.1, within seven days of the appearance of this advertisement. Please state for which post application is being made. [4950

SUPACOILS
OFFER

Model 30 Coil Pack.—The 3-waveband superhet pack with adjustable iron cored coils and trimmers for absolute accuracy in padding and tracking. This pack is gaining more and more favour among experienced engineers and amateurs for its sound design, high quality workmanship and high sensitivity and selectivity, fully aligned. **27/9** (inc.)

Model 40 Coil Pack.—Similar to the Model 30 but with RF stage, fully aligned. **54/6** (inc.)

Model 30 Tuning Unit.—This is now one of the most popular units for easy and efficient superhet construction. It consists of a Model 30 coil pack, pair "MM" I.F. transformers, 2-gang condenser and attractive dial. Components are aligned together as a unit in an actual receiver and sealed. No further alignment is required ...... **54/9** (inc.)

Model 40 Tuning Unit.—Similar to above with provision for R.F. stage ...... **86/3** (inc.)

FREE. A Free Copy of the enormously successful HOME CONSTRUCTOR'S HANDBOOK will be given to every purchaser. Or a copy can be obtained for **1/-** from

SUPACOILS (Mail Order Office)
98, Greenway Avenue, London, E.17

TAMSA
High Quality Tape Recording Components

RECORD HEADS	OSCILLATORS
PLAYBACK HEADS	AMPLIFIERS
ERASE HEADS	PRE-AMPLIFIERS

COMBINED RECORD-PLAYBACK HEADS
FREQUENCY CORRECTING NETWORKS
TAPE, Plastic Base, 600ft., 1,200ft., 3,250ft.
SPOOLS, 600ft., 1,200ft., 3,250ft.

Comprehensive Booklet "Magnetic Tape Recording." Price 5/4 Post Free (G.B.)

Write for latest Price List.

AUDIGRAPH LTD.
Dept. MR3, 74, Great Hampton Street, HOCKLEY, BIRMINGHAM, 18.

— You can master —
MATHEMATICS

If you wish to understand radio really thoroughly you must know Mathematics. Our new Home-Study Courses make them really interesting and easy to learn.

T. & C. RADIO COLLEGE
Specialists in Home-Study Tuition in Mathematics, Radio & Television

Write for free booklet "W" to:—
R. Heath Bradley, T.C.R.C.
50, Harland Road,
SOUTHBOURNE, BOURNEMOUTH.

LYONS RADIO

Signal Generators, Type B3-C. Manufactured by famous maker. Frequency range 30 Mc/s to 100 Kc/s. Calibration accuracy ± one per cent. Output voltage variable from 1 microvolt to 100 millivolts. Intnl. and extnl. modulation facilities, etc., etc. Operation from 100-250 v. A.C. mains. Usual list price £30. Condition as brand new, our price **£18/10/-**.

Receiving Units Type 184. Partly dismantled by us we supply these units fitted with 7 valves type VR65 (all O.K.), chock full of condensers, resistors, wire-wound pots., iron dust cored coils, etc. Overall case size approx. 16¾ × 13¾ × 7¾in. An excellent source of spare parts especially for the T.V. constructor. PRICE **17/6**. Carriage 4/-.

Aerial Masts. 4-sectioned aerial masts consisting of four lengths of stout all-weather resisting paxolin tubing (2¼in. max. dia., ⅛in. wall). Each section fits together with metal ferrules forming a mast 28ft. in height. Very light weight and can easily be raised by one man. Price **42/-**, carr. 4/-. Two top sections only forming a 14ft. mast. Price **18/6**, carr. 2/-.

3 GOLDHAWK ROAD (Dept. M.W.)
SHEPHERDS BUSH, LONDON, W.12
Telephone: **Shepherds Bush 1729**

No. 19 TRANSMITTER—RECEIVER UNITS

Once again we have been fortunate to secure a limited number of these useful chassis. They were in most cases brand new and of Canadian manufacture, but to conform to regulations were partially dismantled by the Ministry before release, and are sold by us for the major components, which include: 1 4 gang .0005 Tuning Condenser, 1 single .0005 Tuning Condenser, each fitted with slow motion dials, 5 I.F. Transformers, approx. 15 valve holders, several pots, Yaxley type switches, ceramic Trimmers and several spare condensers, resistors etc. Our Special Price is **12/6** Carriage Paid. We regret that when we last advertised these chassis the colossal demand exhausted all our stocks and we were forced to disappoint certain customers. If these customers will again apply, their orders will have preference.

POWER UNIT for the above works direct from a 12 or 24 v. Battery and is actually 2 units in one ie Rotary Transformer and a Vibrator Unit; output 500 v. at 120 m/A and 240 v. at 26 m/A. Brand New, Canadian manufacture; also contain Fuses, Indicator Lamp, Change over switches, etc. A Few only, at **49/6** Carriage Paid. We can also supply a spare Brand New valve type OZ4 and Rectifier unit Mallory type 5826C for **10/-** if ordered with this unit.

TELEVISION ENTHUSIASTS! Low loss Di-pole Insulator, with heavy brass studs, for your own Elements, to suit London or Birmingham. The basis of any ultra-efficient Aerial Installation. Only **5/-** each. Send S.A.E. for latest lists.

WALTON'S WIRELESS STORES
203, STAVELEY ROAD, WOLVERHAMPTON
(Mail Orders)
48, STAFFORD STREET, WOLVERHAMPTON
(Callers Only)

THIS IS

REOSOUND

REG. TRADE MARK

MANUFACTURERS

of

SOUND REPRODUCING EQUIPMENT

and

ACCESSORIES

LOUDSPEAKERS • SPECIALIST AMPLIFIERS • SINGLE AND TWIN TURNTABLE UNITS LINE TRANSFORMERS RUBBER SHROUDED LOUD-SPEAKER CONNECTORS

also

ASSOCIATED SHEET METAL WORK

RACKS • PANELS • CHASSIS INSTRUMENT CASES • AMPLIFIER CABINETS. INCLUDING PACK-FLAT EXPORT VERSION FINISHES IN GLOSSY & WRINKLE STOVED ENAMEL

ILLUSTRATED LISTS ON REQUEST. TRADE TERMS ON APPLICATION.

REOSOUND ENGINEERING & ELECTRICAL COMPANY, "Reosound Works," Coleshill Road, Sutton Coldfield.

Grams: Reosound, Sutton Coldfield. Tel.: SUT. 4685.

THE TONEMASTER AMPLIFIER

Sensational new audio amplifier by N.R.S. The most flexible on the market today. Three channels: bass lift, treble lift, middle lift, treble cut, negative feedback. For A.C. 110-250v. 5 watts output, impedance to suit your speaker (please state). Input for magnetic, crystal or h-fi pickup, full provision for tuner. Price (fully guaranteed and tested), **£8/19/6**. Immediate delivery. Not available as Kit or Blueprints.

NO. 1 HIGH QUALITY TUNER, specially recommended for above amplifier and Wireless World Williamson & Charles Amplifiers. L. and M. wave T.R.F. infinite impedance detector. Absolutely complete, built and tested, **£5/10/-**. Ditto Kit, **£4/10/-**.

NO. 2 L.M. AND S. WAVE SUPERHET., special quality bandwidth, beautiful full-vision dial assembly (10 x 4½in. scale), **£8/10/-**. Ditto Kit, **£7/10/-**.

12-WATT PUSH-PULL AUDIO AMPLIFIER for A.C. 110-250v. Inputs for twin turntables, mike and tuner, special feedback circuit, 3, 7.5 and 15 ohms output. Price **10 gns**. Complete Kit, **£9**. Deluxe black crackle case with chromium handles, **£2** extra.

LATEST GRAM UNITS. Collaro RC49 A.C. mixed 8-record changer, crystal pickup, **£14/6/8**. Collaro RC500 A.C. non-mixed 9-record changer, with crystal pickup, **£10/15/-**; with hi-fi lightweight, **£11/15/-**. Marconi ACT00 non-mixed 10-record changer with hi-fi lightweight pickup and transformer, **£10/10/7**. Collaro AC504 single record player, with mag. pickup, **£5/3/2**; with hi-fi lightweight, **£7/0/6**. Collaro AC47 centre-drive motor with 12in. non-magnetic turntable, **£5/18/4**.

Full range **WHARFEDALE SPEAKERS** and crossover units in stock.

TELEVISION CONSTRUCTORS! Full range of components for **VIEWMASTER** (London and Midland) and **ELECTRONIC ENGINEERING** (London and Midland) available.

FULL BARGAIN CATALOGUE, 2½d. **TERMS**: c.w.o. or c.o.d. any amount.

Northern Radio Services,

16, King's College Road, Swiss Cottage, London, N.W.3.

Primrose 8314

APPLICATIONS are invited from electronic engineers for permanent positions in a successful and expanding organisation near Esher, Surrey; a wide range of vacancies exists for development engineers, circuit designers, coil and transformer designers, at both senior and junior levels; the work will deal with a new and interesting series of projects, and will involve application of techniques as used in radar and radio receivers and transmitters, cathode ray tube displays, filters and networks (excluding wave guides), etc.; candidates for the senior posts should possess an honours degree or equivalent qualification, and have considerable design experience in at least one of these branches; salaries offered will be commensurate with age, qualifications and experience, and the positions will be progressive with excellent prospects for suitable applicants; working conditions are ideal with pleasant and congenial surroundings, and first-class canteen facilities are available on the premises.—Applicants must state age, nationality, qualifications, experience and salary required, to Box 2016. [4927

SITUATIONS WANTED

ELECTRONICS consultant seeks post anywhere in South America.—Box 2066. [4969

YOUNG man, 22, single, moving to London from Yorkshire, qualified service engineer, seeks position with scope for initiative in sales or service.—Box 2008. [4909

BUSINESSES FOR SALE AND WANTED

PROGRESSIVE business in thriving Bucks community, radio, television, electrical contracting, cycles; good agencies; freehold property includes double-fronted shop, pleasant living accommodation, garage, good garden; £6,000; s.a.v.—Box 2056. [4962

PROMINENT position, well-known main road, West London, fine, deep shop, with store and service room behind, great scope for enterprising person; price all at, including good stock, £1,500; scope for cycles and records; flat of 4 rooms available.—Box 2048. [4952

WEST London.—Small manufacturing business making well-known quality product, for sale as going concern; valuable lease of fine corner premises; scope for retail business if necessary; company has well-known and respected name; price all at (including about £2,000 stock), £3,500; golden opportunity for person with initiative and necessary capital.—Box 2049. [4953

WEST LONDON.—Small manufacturing concern, whose name is now a household word for a quality product, wish to dispose of their business owing to ill-health; premises comprise fine corner shop in improving position, with facilities for retail business if necessary; the product is well-known and the best of its kind in Gt. Britain; a low price based on value of lease and stock would be accepted with benefit of past advertising and rapidly growing clientele; this is a wonderful opportunity for genuine bona fide person seeking a good business with ample scope and opportunity; price, including good stock, about £2,500.—Write, Box 2070.

FINANCIAL PARTNERSHIPS

FIRST-CLASS directorship offered keen man with knowledge of audio amplifiers and recording; company is well known and makes the finest product of its kind in the country; capital required about £2,000; this represents a genuine offer with great possibilities to the right man with necessary qualifications.—Box 2050. [4954

PATENTS

THE proprietor of British Patent No. 573515, entitled "Multiple section electronic tube and method of making it," offers same for licence or otherwise to ensure practical working in Great Britain.—Inquiries to Singer, Stern & Carlberg, 28 E. Jackson Boulevard, Chicago 4, Illinois, U.S.A. [4827

TECHNICAL TRAINING

A.M.I.E.E., City and Guilds, etc., on "no pass, no fee" terms; over 95% successes. For full details of modern courses in all branches of electrical technology send for our 176-page handbook—free and post free.—B.I.E.T. (Dept. 388A), 17, Stratford Place, London, W.1. [6270

TUITION

UNIVERSITY College, Southampton.—Department of Electronics.

The Department of Electronics (Professor E. E. Zepler) gives an advanced course at Honours Degree standard in electronics. The course is full time for one academic year and the college grant a diploma by examination to students who successfully complete the course. Entry qualification is a university degree in physics or electrical engineering, or its equivalent. The fourth of these courses will commence in October, 1950, and application for admission should be made now to the Academic Registrar, from whom further details may be obtained. [4925

RADIO training.—P.M.G. exams. and I.E.E. Diploma; prospectus free.—Technical College, Hull. [0611

WIRELESS, land, sea and air; students, both sexes, age 14 upwards, trained for interesting appointments in all branches of radio; low fees; boarders accepted; 2d stamp for prosp.—Wireless College, Colwyn Bay. [0018

A.M.I.Mech.E., A.M.Brit.I.R.E., City and Guilds, etc., on "no pass—no fee" terms, over 95% successes. For details of exams. and courses in all branches of engineering, building, etc., write for 176-page handbook—free.—B.I.E.T. (Dept. 387B), 17, Stratford Place, London, W.1. [1377

TELEVISION postal course for radio trades Examination Board's diploma; also postal courses for P.M.G. 2nd and 1st class Certificates and Amateur Radio Transmitting licence.—Apply British School of Telegraphy, Ltd., 179, Clapham Rd., London, S.W.9. (40 years' experience in coaching students in wireless telegraphy and allied subjects.) [2586

NUSOUND PRODUCTS

136 WARDOUR ST., LONDON, W.1

Tel. GERrard 8845

RADIO, TELEVISION AND ELECTRICAL.
FULL MAIL ORDER FACILITIES (add postage).
Mon.-Fri., 9-5.30 p.m. Sat. 9-1 p.m.

A QUALITY AMPLIFIER TO SUIT ALL POCKETS. A self-contained compact 4-valve amplifier chassis with an output of approx. 4½ watts. Includes 3-stage negative feedback circuit and incorporates independent Bass and Treble boost controls. Sufficient spare H.T. and L.T. for operation of small R.F. Feeder unit. Complete constructional booklet including circuit, layout diagrams and pictures for A.C. and A.C./D.C. models. Price **1/6**.

Complete kit of components including drilled All chassis and NEW VALVES. A.C. Model, **£8**. A.C./D.C. Model, **£8**.

Fully constructed amplifier with 12 months guarantee (except valves). EITHER MODEL, **£10/10/-**, post free.

Either model fitted with separate microphone input and independent mic. volume control for **15/-** extra. R.F. Feeder Unit Booklet for A.C. or A.C./D.C. operation available middle March. Price **1/6**.

NUSOUND TRANSFORMERS. (Tapped pri. unless otherwise stated.)

A few selections from our wide range, and we can wind to your own spec. delivery 4 days. Estimates free.

350-0-350 v. 100 mA., 6.3 v. 3 a., 5 v. 2 a. or 4 v. version, **£1/4/3**.

250-0-250 v. 75 mA., 6.3 v. 3 a., 5 v. 2 a., or 4 v. version, **£1/1/9**.

[illegible] v. 60 mA., 6.3 v. 3 a., 5 v. 2 a. or 4 v. version, **£1/0/3**.

[illegible] v. 40 mA., 6.3 v. 3 a., 5 v. 2 a. or 4 v. version, **18/9**.

6.3 v. 1½ a. Heater trans. 230 pri. only, **6/9**.

4 v. 2 a. Heater trans., 230 pri. only, **6/9**.

6 v. 6 a. C.T. Heater trans., 230 pri. only, **15/6**.

NUSOUND CHOKES.

CH4, 10 H. 150 Ω 75 ma., **4/6**.

CH5, 10 H. 300 Ω 60 ma., **4/6**.

CH10, 15 H. 250 Ω 80 ma., shrouded, **10/9**.

CH8, 10 H. 300 Ω 100 ma., shrouded, **9/6**.

CH9, 10 H. 100 Ω 150 ma., shrouded, **10/6**.

CH12, 5 H. 80 Ω 250 ma., shrouded, **19/6**.

OUTPUT TRANSFORMERS.

OP1, 50 ma. Pen. [illegible] kΩ, **4/9**.

OP8, 40 ma. Pen. 7 kΩ, **5/6**.

OP9, 40 ma. Multi Ratio, **7/-**.

OP10, 100 ma. 7 kΩ to 2 Ω, **12/6**.

OP11, 100 ma. 10 kΩ to 2 Ω, **12/6**.

Hi. Fi. [illegible] kΩ to 2 or 15 Ω, **15/-**.

Hi. Fi. Push Pull, 20 w., **28/6**. State ratio.

VIEWMASTER TELEVISOR. (Working model on view.)

Full constructional envelope including stage by stage blueprints and complete price list, **5/-**.

Complete kits of components available as follows:—Whiteley kit, **£6/5/-**; T.C.C. kit, **£6/15/-**; Plessey kit, **£5/12/6**; Colvern pots, **19/3**; G.E.C. tran., **2/9**; Bulgin kit, **12/6**; Belling & Lee kit, **8/6**; Westinghouse, **£1**; Resistor kit, **£1/6/9**; Morganite pots, **9/-**.

Individual components can also be supplied.

TELEVISION AERIALS CAN BE SENT TO ANY PART OF THE COUNTRY.—Send for List.

Garrard mixed 10 or 12 inch record changer with Hi-Fi stylus head. Incl. Tax, **£17/7/9**.

Collaro 10in. or 12in. record changer, model RC500, with crystal or magnetic head. Incl. Tax, **£10/15/-**.

Tinned copper wire in ½lb. reels; 18 s.w.g., **1/3**; 20 s.w.g., **1/4**; 22 s.w.g., **1/6**.

Enamel copper wire, in ½lb. reels; 18 s.w.g., **1/3**; 20 s.w.g., **1/4**; 22 s.w.g., **1/6**; 24 s.w.g., **1/8**; 26 s.w.g., **1/9**; 28 s.w.g., **1/10**; 30 s.w.g., **1/10**; 32 or 34 s.w.g., **2/-**; 36 or 38, **2/2**; 40 s.w.g., **2/6**.

C.R.T. Masks. 6in. black, **6/8**; 9in. black, **9/6**; 9in. stone, **11/3**; 12in. black, **18/-**, stone, **21/6**.

Cathode Ray Tubes. From stock. 9in. Mullard MW 22-14c, Mazda CRM 92; G.E.C. 6504. Incl. Tax, **£11/6/10**. Mullard, Mazda or Ferranti 12in. tube, Incl. Tax, **£15/2/5**.

LET US QUOTE YOU BY RETURN OF POST FOR COMPONENTS OF ALL TYPES.

EX STOCK.

Build your own chargers with these reliable and efficient L. T. RECTIFIERS. Fully guaranteed and delivery ex stock.

L.T. 41.	12V. 1A.	**30/6d.**
L.T. 42	6V. 1A.	**23/8d.**
L.T. 45.	6V. 4A.	**45/2d.**

Dept. W.W. 3A
Westinghouse Brake & Signal Co., Ltd.
82 York Way, King's Cross, London, N.1.

B. & H. RADIO

BASS & TREBLE SEPARATOR
kit of parts £1 9 6

SCRATCH FILTER
Gives a marked reduction of scratch level without serious effects on treble response 15 0

VARIABLE SELECTIVITY I.F. TRANS.
465 kcs. Gives 3 degree of selectivity ..... per pair £1 0 0

TONE CONTROL UNIT
To connect to any equipment and gives independent control of bass and treble £4 10 0

MAINS FILTERS.
To eliminate mains borne interference. The four chokes are dust iron cored and the condensers are 1 KV. wkg. Cases are metal with inlet and outlet bushes 17 6

B. & H. RADIO
EAST STREET,
DARLINGTON.

INSTRUMENT WIRE
ENAMELLED, D.C.C. SILK COVERED
ETC. all sizes from 10 s.w.g. to 42 s.w.g. in stock.
INSULATING MATERIALS. Empire cloth, vetheroid, paxolin, sleeving etc.
Send S.A.E. for list to
STAN. HOLT,
340, HIGH ST. SMETHWICK, STAFFS
Telephone: WOODGATE 1739

TYPE G (B7G BASE)

ENQUIRIES FOR ALL TYPES INVITED

BROOKES CRYSTALS LTD.
10 STOCKWELL STREET,
GREENWICH, LONDON, S.E.10.
PHONE GRE 1828 CABLE XTALS LONDON

POST RADIO SUPPLIES

OFFER EX STOCK

COPPER INSTRUMENT WIRE
ENAMELLED, TINNED, LITZ, COTTON AND SILK COVERED
Most gauges available.
B.A. SCREWS, NUTS, WASHERS, soldering tags, eyelets and rivets.
EBONITE AND BAKELITE PANELS, TUFNOL ROD, PAXOLIN TYPE COIL FORMERS AND TUBES, ALL DIAMETERS.
Latest Radio Publications.
Send stamped addressed envelope for comprehensive lists. Trade supplied.

POST RADIO SUPPLIES
13, Bourne Gardens, London, E.4.
Phone: CLissold 4680

WIRELESS officer's attendance and Radioperia postal course.—Apply Manager, The Wireless School, Manor Odns, London, N.7. (10025)

ELECTRONICS engineering and radio.—Next courses commence April, 1950. We are now compiling our list of students for our 1-year, 2-year and 5-year daytime courses in radio and general electronics engineering. 5-year course includes 1-year practical training in our factories at Hayes, during which time the student is paid. Apply for free booklet giving full details of these and other courses. E.M.I. INSTITUTES, Dept. W.W., 10, Pembridge Sq., Notting Hill Gate, London, W.2. Bayswater 5131-4. (10001)

TELEVISION.—The Gothic Television School specialises solely in training in television. All tutors possess university degrees and/or corporate membership of professional institutions and are appointed individually to postal course students to ensure complete and thorough training. Principals: M.B.E., B.Sc., M.Brit.I.R.E., education committee members, etc. Courses assume no previous television knowledge and provide guaranteed training for Brit.I.R.E. and R.T.E.B. examinations. Numerous well-known companies have adopted the School's Basic Television Course as standard television training for their staffs. Moderate fees. Details from Gothic Television School, 13 North Avenue, London, W.13. (10051

BOOKS, INSTRUCTIONS, ETC.

TELEVISION Servicing Manual, fault tracing charts, circuits of commercial receivers; posted 4/-.

THE Oscilloscope, Design and Construction, by A. J. Hopkins. The most recent manual; posted 4/-.

INTERNATIONAL Radio Tube Encyclopaedia. A few copies still available; post paid 42/-.

QUADRANT BOOKS (DEPT. 9), 17, Quadrant Arcade, Regent St., London, W.1. (1960

"HOME Construction Handbook," the latest edition of this famous handbook containing circuits, radio constructional and servicing hints and complete catalogue, is now available at only 1/-, mail order only.

SUPAOIDLE, 86, Greenway Ave., London, E.17.

WEBB'S 1950 radio map of world, new multi-colour printing, with up-to-date call signs and fresh information on heavy air noise, 4/6 post 6d., on linen on rollers, 11/6 post 9d. Webb's Radio, 14 Soho St., W.1. Geraid 2089.

SUTTON Coldfield edition of the "Viewmaster" now available, 5/- plus 6d. post, includes 8 full-size, stage-by-stage assembly drawings and 52 page instruction book; demonstration set may be inspected during programme hours, and our service dept. will put you right if you have any troubles in building.

FRITH RADIOCRAFT, Ltd., Leicester. (10028

WANTED

A man with first-class technical knowledge of TELEVISION, to answer telephone queries. Must also have some typing ability.

Prospects of more important position later.

Salary £350 p.a. to commence.

PREMIER RADIO COMPANY
167, Lower Clapton Road, London, E.5

★ **"Globe-King"** (REGD) MARVEL IN MINIATURE
SHORT-WAVE RADIO KIT
Probably the smallest one valve Short-Wave Radio receiver in the world using standard parts with Bandspread tuning device. "Regenflexer performance" . . . valve recommends British foils and filament. Built and designed to precision standards, complete kit costs only 49/6d.—write today for descriptive catalogue.
JOHNSONS (RADIO SPECIALISTS) **MACCLESFIELD** CHESHIRE (ENG)

Unquestionably the best
TELEVISION PRE-AMPLIFIERS
as a trial will prove!
SPENCER WEST, QUAY WORKS, Gt. YARMOUTH

★

"Radiospares" Quality Parts

The Service Engineer's First Choice

★

ELECTRONICS
DUPLEY
LTD.
CRANMER AV. EALING.W.13.
Transformer and Coil Manufacturers to the Trade
Telephone: EALing 2099

RUNBAKEN · MANCHESTER 1

★

LUDLOW & COLE
PICKETTS AVENUE
LEIGH-ON-SEA
ESSEX
Tel.: Southend 76589

Specialists in Transformers

★

COVENTRY RADIO
COMPONENT SPECIALISTS SINCE 1925

SPECIAL OFFER

New ½ watt Resistors, popular make, 25 standard values.

ASSORTMENT OF 100 FOR 15/-
(List Price value 50/-)

This is an opportunity not to be missed. Stock your workshop now while stocks last.

COVENTRY RADIO
109, DUNSTABLE RD., LUTON, BEDS.

NEW STC SELENIUM RECTIFIERS
Largest L.T. range from stock in Gt. Britain. Current products, NOT surplus. Owing to makers' price increase on November 11 last, we are now compelled to revise ours as below. E.H.T. H4/200, "W.W." Televisor, **29/3**. H4/100, VR97, **19/5**, post free.

HALF-WAVE RECTIFIERS.
16v. 1a., **7/-**; 1a., **8/5**; 2a., **9/10**; 3a., **16/9**, all post 6d.; 4a., **18/-**; 6a., **22/6**, post 10d.; 30v. 1a., **12/5**; 2a., **14/9**; 4a., **25/-**; 6a., **37/10**; 48v. 2a., **21/-**; 4a., **37/3**; 6a., **53/7**; 100v., 2a., **36/3**; 4a., **68/3**; 6a., **99/9**, all post 1/-.

HALF-WAVE HEAVY DUTY, 7½IN. SQUARE COOLING FINS.
16v. 5a., **22/4**; 10a., **24/6**; 30v. 5a., **36/9**; 8a., **40/5**; 48v. 2.5a., **26/9**; 5a., **50/5**; 8a., **56/9**, all post 1/-.

BRIDGE CONNECTED FULL WAVE.
17v. 1.5a., **12/9**; 2a., **16/4**; 2.5a., **21/6**; 3a., **22/10**; 4a., **26/-**; 5a., **27/-**, all post free; 33v. 2a., **19/5**; 1a., **22/4**; 1.5a., **29/6**; 2a., **31/9**; 3a., **37/6**; 4a., **45/4**; 5a., **46/-**, all post 10d.; 54v. 1.5a., **41/-**; 2a., **49/11**; 4a., **68/3**; 72v. 1.5a., **52/6**; 2a., **64/1**; 100v. 1.5a., **75/7**, all post 1/-.

BRIDGE CONNECTED HEAVY DUTY, 7½IN. SQUARE COOLING FINS.
17v. 6a., **36/2**; 10a., **44/-**; 12a., **75/7**; 20a., **84/-**; 33v. 6a., **67/3**; 10a., **74/7**; 12a., **133/3**; 20a., **157/-**; 54v. 6a., **94/6**; 10a., **105/-**; 72v. 10a., **136/-**; 100v. 10a., **199/6**, all post 1/4.

BRIDGE INDUSTRIAL FUNNEL COOL
17v., 12a., **79/10**; 20a., **91/4**; 30a., **138/-**; 50a., **197/5**; 33v. 6a., **72/6**; 10a., **84/-**; 12a., **130/3**; 20a., **151/3**; 54v. 6a., **96/7**; 10a., **113/5**; 72v. 6a., **119/9**; 10a., **146/10**; 100v. 6a., **148/-**; 10a., **210/-**, all post 1/6.

VALVE CHARGER REPLACEMENTS.
No wiring alterations. Philips & Tungar.

Wholesale & Retail

T. W. PEARCE (Est. 18 yrs.)
66 GREAT PERCY STREET, LONDON, W.C.1
Off Pentonville Rd. Between King's Cross and Angel

BRASS, COPPER, DURAL, ALUMINIUM, BRONZE
ROD, BAR, SHEET, TUBE, STRIP, WIRE.
3,000 STANDARD STOCK SIZES
No Quantity too Small *List on application*
London: H. ROLLET & Co., Ltd. Liverp'l:
6, Chesham Place, S.W.1. Kirkby Estate,
SLOane 3463 *SIMONSWOOD 327113*

LOCKWOOD
makers of
Fine Cabinets
and woodwork of every description for the Radio and allied trades
LOCKWOOD & COMPANY
Lowlands Road, Harrow, Middlesex. Byron 3704

TELEVISION RECEIVERS
SCANNING and FOCUS COILS
TIME BASE COMPONENTS
7KV. EHT. RF. UNITS and TRANSFORMERS
HR
Publications post free
HAYNES RADIO LTD.
Queensway, Enfield.

COPPER WIRE AND INSULATION MATERIALS, etc. Most gauges in stock. Leathoid, Fibre, Mica, Varnish, etc. Also many other Radio, Electrical and Mechanical bargains at attractive prices. ELECTRIC MOTORS FOR SALE ALL AT BARGAIN PRICES. REV. COUNTERS, **3/6** each.
Send S.A.E. for List.
L. C. Northall, 16, Holly Road, Quinton, Birmingham, 32.
Tel.: Woo 3161.

VALLANCE'S
FOR THE "VIEWMASTER"!

The Bottom Coldfield data envelope is now available for this receiver at 5/3, post free.

PLESSEY COMPONENTS. Power transformer 72901, **19/3**. Line transformer 72906, **22/-**. Width control 72903, **9/6**. Scanning coil 72901, **26/3**. Focus magnet, 72904/5, **26/6**. Boost choke 72906, **5/9**. Pair of tube supports 72907, **14/9**. Complete set of PLESSEY components, **£6 13/-**.

WHITELEY ELECTRICAL COMPONENTS. Sound-vision chassis, VM 100, **23/3**. Power Pack, Time base chassis VM102, **23/3**. Supporting brackets for VM100, VM101, **5/9**. Heater transformer VM104, **15/9**. Mains Choke VM104, **13/3**. Magnetic speaker VM105, **28/3**. Brand set of WHITELEY components, **£6 6/-**.

WESTINGHOUSE COMPONENTS, set of five metal rectifiers, **£3 3/6**.

BULGIN COMPONENTS. Complete set containing fuse holder, plugs and sockets, on/off switch etc., **13/3**.

T.C.C. CONDENSER KIT. Complete set of condensers. London set, **£5 16/-**. Midland set, **£7 1/-**. Complete set of **COLVERN** potentiometers, **20/-**.

BELLING LEE. Mains connector unit L707, less fuses and neon bulb, **8/3**. Fuses **6d.** each.

WHITE TUBE MASKS. 9in. **13/3**; 10in., **21/9**.

COILS—WRIGHT & WEAIRE. Midland, 14 iron-cored coils and 1 R.F. Choke, 9/10, **31/-**. London coils and chokes, **21/-**.

MORGANITE RESISTORS. Midland resistor pack (10 resistors) 71921, **26/9**. London pack (60 resistors), **27/6**. 1 variable 100 k., **5/3**. 1 variable 500k., **5/3**.

CASINETS. As specified, iron, tube size, complete with back, cover and plate, and four matched knobs, **£7 2/6**.

CATHODE RAY TUBES. Nine-inch, Mullard MW22/14, G.E.C. 6001, Mazda CME2, all **£11 6/10**, including tax. Twelve-inch, Mazda CRM121, **£15 2/5**, including purchase tax. Flyer (single 3/- to cover carriage when ordering tubes.

When ordering components, please state whether for "London" or "Birmingham."

VALLANCE & DAVISON LTD.
144, Briggate, Leeds, 1
'Phone 29428-9

THE MODERN BOOK CO.

The Principles of Television Reception. By A. W. Keen. **30s.** Postage 9d.
Television Explained. By W. E. Miller. **5s.** Postage 5d.
Radio Receiver Design. By K. R. Sturley. Volumes 1 and 2. **28s.** each. Postage 9d.
A Manual of Vacuum Practice. By L. H. Martin and R. D. Hill. **10s. 6d.** Postage 3d.
Television Servicing Manual. By E. N. Bradley. **4s. 6d.** Postage 3d.
The Electronic Musical Instrument Manual. By Alan Douglas. **18s.** Postage 6d.
Sound Reproduction. By G. A. Briggs. **7s. 6d.** Postage 4d.
Amateur Radio Receivers. By S. K. Lewer. **3s. 6d.** Postage 2d.
Wire Recorder Manual. By G. R. Judge. **2s. 6d.** Postage 2d.
Radio Valve Data. Compiled by "Wireless World." **3s. 6d.** Postage 3d.
Basic Mathematics for Radio Students. By F. M. Colebrook. **10s. 6d.** Postage 4d.
The Cathode-Ray Tube Handbook. By S. K. Lewer. **6s.** Postage 3d.
A Home-built Televisor for Sutton Coldfield Reception. By W. I. Flack. **4s. 6d.** Postage 3d.
Radio Receiver Servicing and Maintenance. By E. J. Lewis. **8s. 6d.** Postage 5d.
Principles of Radar. By M.I.T. **33s.** Postage 1s.
Newnes Electrical Pocket Book. Ed. E. Molloy. **7s. 6d.** Postage 6d.

We have the finest selection of British and American radio books in the country. Complete list on application.

19-23 PRAED STREET
(Dept. W.3)
LONDON W.2
PADdington 4185

YOUR METER DAMAGED ?

Leading Electrical Instrument Repairers to the Industry.

Repairs to actual customers to all makes and types of Voltmeters, Ammeters, Microammeters, Multiranges, Test meters, Electrical Thermometers, Recording Instruments, Synchronome Clocks, etc. Quick turnround—the speedy estimate and detective instrument for registered post to

L. GLASER
SCIENTIFIC & ELECTRICAL INSTRUMENT REPAIRERS
341 CITY ROAD, E.C.1
Tel. Terminus 2489

BRIDISCO

CRYSTAL SET, 9/2. Housed in a sturdy bakelite cabinet and complete with fully shielded permanent detector.
Permanent Detector, 2/6. Crystal and Whisker, 6d. Cats Whisker Detector Kit, 1/9. Tapped Coil, 3/6. Diode Valve Crystal, 4/6. Experimenters' Crystals, 3/- for six assorted.
Headphones.—High resistance, **15/-**; low resistance with special balanced armature units, perfect for crystal sets **7/6**.

TELEVISION MIDLANDS. A complete set of coils and chokes for sound and vision panels, wound under strict laboratory supervision to "Electronic Engineering" Specification. **19/6.**

From your local retailer, usual factor or —
BRITISH DISTRIBUTING CO.,
66 HIGH STREET LONDON, N.8.
SEND FOR LITERATURE

SOLONS FOR YOUR SOLDERING JOBS !

Types available—65 watt oval tapered bit, 65 watt round pencil bit, 125 watt oval tapered bit, 125 watt round pencil bit, 240 watt oval tapered bit.

These five models will satisfy practically every soldering demand whether for the occasional household job or continuous soldering under workshop or factory conditions. With the Solon the heat is in the bit itself . . . continuously . . . hour after hour; all connections housed at end of handle away from heat. Each model complete with 6 feet Henley 3-core flexible. Now available from stock. Write for folder Y.10.

W. T. HENLEY'S TELEGRAPH WORKS CO. LTD.
51-53 Hatton Garden, London, E.C.1

INDEX TO ADVERTISERS

	PAGE
Acru Electric Tool Mfg. Co., Ltd., The	82
Adcola Products, Ltd.	42
Aerialite, Ltd.	12
Airmec Laboratories, Ltd.	19
Albert Mfg. Co.	80
Allan Richard, Radio, Ltd.	86
Allen Components, Ltd.	71
Alpha Accessories, Ltd.	14
Ambassador Radio	28
Antiference, Ltd.	Edit. 119
Armstrong Wireless & Television Co., Ltd.	89
Ashworth, H.	73
Atkins, H. C., Laboratories	86
Audigraph, Ltd.	92
Automatic Coil Winder & Electrical Equipt. Co., Ltd.	1, 84
B. & H. Radio	94
Bakers "Selhurst" Radio	70
Barker, A. C.	87
Beethoven, Ltd.	96
Belling & Lee, Ltd.	49
Berrys (Short Wave), Ltd.	88
Bird, S. S., & Sons, Ltd.	24
Birmingham Sound Reproducers, Ltd.	44, 50b
Boscombe Radio & Electric	76
Brierley, J. H. (Gramophones & Recordings), Ltd.	22
Britain, Chas. (Radio), Ltd.	69
British Communications Corpn., Ltd.	34
British Distributing Co.	95
British Institute of Engineering Technology	82, 96
British Insulated Callender's Cables, Ltd.	Cover ii
British National Radio School	84
British Physical Laboratories	52, 68
British Rola	52
Brookes Crystals, Ltd.	94
Brown, S. G., Ltd.	34
Bulgin, A. F., & Co., Ltd.	Edit. 119
Bull, J., & Sons	79
Bullers, Ltd.	71
Bush Radio, Ltd.	24c
Cabot Radio Co., Ltd.	84
Candler System Co.	80
Car & General Radio	82
Champion Products	82
Chapman, C. T. (Reproducers), Ltd.	76
Charles Amplifiers, Ltd.	13
Chloride Batteries, Ltd.	18
C. J. R. Elec. and Electronic Development, Ltd.	74
Cinema-Television, Ltd.	27
Clydesdale Supply Co., Ltd.	56
Cohen, D.	83
Cosmocord, Ltd.	48
Cossor, A. C., Ltd.	11
Coulphone Radio	89
Coventry Radio	94
Davis, Alec, Supplies, Ltd.	66
Davis, Jack	72
Drayton Regulator & Instrument Co., Ltd.	38
Dubilier Condenser Co. (1925), Ltd.	24a
Duke & Co.	80
Dupley Electronics, Ltd.	94
Edison Swan Electric Co., Ltd.	51
Electradix Radios	79
Electrical Sound & Television Patents, Ltd.	74
Electro Acoustic Developments	72
Electronic Instruments, Ltd.	66
Electronic Precision Equipment	60, 61
E.M.I. Institutes	42, 54
Ela Tool Co. (Leicester), Ltd.	20
Ferranti, Ltd.	5
Fielden (Electronics), Ltd.	73
Filmer, J. T.	90
Fluxite, Ltd.	Edit. 117
Frith Radiocraft, Ltd.	86
Furzehill Laboratories, Ltd.	6
Galpins	83
Gardners Radio, Ltd.	50
Garland Radio	78
General Electric Co., Ltd.	88, 17
General Lamination Products, Ltd.	18
Glaser, L.	95
Goodmans Industries, Ltd.	8
Goodsell, Ltd.	2
Gramophone Co., Ltd.	50e
Gray, A., Ltd.	16
Hallam, Sleigh & Cheston, Ltd.	54
Hartley, H. A., Co., Ltd.	78
Hatfield Instruments	86
Haynes Radio, Ltd.	95
Hell-Mann Electronics Laboratories	41
Henley's, W. T., Telegraph Works Co., Ltd.	95
Henry's	84
Hill & Churchill, Ltd.	92
Hivac, Ltd.	8a
Hogg, F. Livingston	22
Holley's Radio Stores	84
Holt, Stan	94
Houghton & Osborne	40
H. P. Radio Services, Ltd.	64
Hunt, A. H., Ltd.	24f, 40
Imhof, A., Ltd.	87
Industrial Electronics	41
Inter Electron Industries	22
International Correspondence School, Ltd.	18
Jackson Bros. (London), Ltd.	10
Johnsons (Radio)	94
Kershaw, S.	72
Lasky's Radio	82
Lawrence, G., & Co.	82
Leak, H. J., & Co., Ltd.	35
Lewis Radio Co.	80
Liquidators Disposal Agency	85
Lockwood & Co.	95
London Central Radio Stores	35
London Radio Supply Co.	91
Lowther Mfg. Co.	86
Ludlow & Cole	94
Lustraphone, Ltd.	72
Lyons, Claude, Ltd.	80
Lyons Radio	92
Mail Order Supply Co.	87
Marconi Instruments, Ltd.	12
Marconiphone Co., Ltd.	50d
Marconi Wireless Telegraph Co., Ltd.	50c
Maurice, Richard Equipment Co., The	86
McMurdo Instrument Co., Ltd.	36
Measuring Instruments (Pullin), Ltd.	24
Metro Pex, Ltd.	10
Metropolitan-Vickers Electrical Co., Ltd.	15
Midland Instrument Co.	74
Modern Book Co.	90
Modern Electrics, Ltd.	88
M.R. Supplies, Ltd.	20
M.S.S. Recording Co., Ltd.	26
Mullard Electronic Products, Ltd.	25, 46
Multicore Solders, Ltd.	Cover iv
Mycalex, Ltd.	43
Northall, L. C.	93
Northern Radio Services	68
Nusound Products	98
Oliver Pell Control, Ltd.	42
Osmor Radio Products, Ltd.	14
Oxley Development Co., Ltd.	70
Painton & Co., Ltd.	53, 75
Park Radio	24
Partmeko, Ltd.	54
Partridge Transformers, Ltd.	77
P.C.A. Radio	74
Pearce, T. W.	95
Pennine Amplifiers	82
Pitman, Sir Isaac, & Sons, Ltd.	70
Plessey International, Ltd.	24d
Post Radio Supplies	94
Pratts Radio	74
Premier Radio Co.	57, 58, 59, 94
Proops Bros., Ltd.	76
Quartz Crystal Co., Ltd.	90
Radio Exchange Co.	68
Radiomenders, Ltd.	70
Radio Servicing Co.	78
Radiospares, Ltd.	94
Radio Unlimited	76
Record Electrical Co., Ltd., The	78
Redifon, Ltd.	41
Reliance Mfg. Co. (Southwark), Ltd.	86
Resound Eng. & Electrical Co.	93
Reproducers & Amplifiers, Ltd.	4
Rotherham & Co., Ltd.	66
Roding Laboratories	16
Rogers Developments Co.	40
Rollett, H., & Co., Ltd.	95
Rothermel, R. A., Ltd.	50
Rubber Bonders, Ltd.	23
Ruco Products	76
Runbaken Electrical Products	90, 94
Salford Electrical Instruments, Ltd.	3
Sangamo Weston, Ltd.	53
Savage Transformers, Ltd.	74
Schalf, Erwin	68
Simmonds Aerocessories, Ltd.	37
Simon Sound Service	3b, 43
Smith, G. W. (Radio), Ltd.	72
Sound Sales, Ltd.	52
Southern Forge, Ltd.	3
Southern Radio Supply, Ltd.	82
Sowter Transformers	96
Stability Radio Components, Ltd.	28
Standard Telephones & Cables, Ltd.	47
Steatite & Porcelain Products, Ltd.	9
Stern Radio, Ltd.	81
Stewart Transformers, Ltd.	52
Stratton & Co., Ltd.	16
Sugden, A. R., & Co. (Engineers), Ltd.	39, 50f
Supacoils	90, 92
Szymanski, S.	14
T. & C. Radio College	92
Taylor Electrical Instruments, Ltd.	4, 50
Taylor, Tunnicliff (Refractories), Ltd.	75
Telegraph Condenser Co., Ltd.	50g, Cover iii
Telegraph Construction & Maintenance Co., Ltd., The	7, 50
Tele-Radio (1943), Ltd.	26
Thermionic Products, Ltd.	29
Thomas, Richard, & Baldwins, Ltd.	50h
Thornber, J. E., & Sons	88
Trix Electrical Co., Ltd.	21
Truvox Engineering Co., Ltd.	33
United Insulator Co., Ltd.	20
Universal Bazaars, Ltd.	94
Universal Electrical Instruments Corpn.	70
University Radio, Ltd.	65, 76
Vallance & Davison, Ltd.	96
Valradio	54
Vitavox, Ltd.	50a
Voigt Patents, Ltd.	42
Vortexion, Ltd.	51
Walton's Wireless Stores	92
Wayne Kerr Labs., Ltd., The	58
Westinghouse Brake & Signal Co., Ltd.	6, 50j, 93
West, Spencer	94
Weymouth Radio Mfg. Co., Ltd., The	28
Wharfedale Wireless Works	26
Whiteley Electrical Radio Co., Ltd.	30, 50k
Wiley Electronics	88
Wireless Instruments (Leeds), Ltd.	88
Wireless Supplies Unlimited	90
Wright & Weaire, Ltd.	45
Young, C. H.	72

AMPLIFIERS Quality KIT for HOME CONSTRUCTORS

A complete set of components to construct a 10 watt amplifier including Woden potted mains transformer, 5 valves, 10 in. speaker with transformer. Components of the highest quality. No Govt. surplus. Three switched inputs, negative feed back, push-pull output, tone control, steel chassis. Suitable home or small hall.

CASH WITH ORDER

Price Complete to the last screw £7 10 0 (Subject)

BEETHOVEN LTD
ELECTRIC EQUIPMENT
Chapel Lane, Sands, High Wycombe Tel: 1152/3

ENGINEERS!

Whatever your age or experience, you must read "ENGINEERING OPPORTUNITIES". Full details of the easiest way to pass A.M.I.Mech.E., A.M.I.E.E., A.M.I.C.E., CITY & GUILDS, MATRIC, etc. on "NO PASS—NO FEE" terms and details of Courses in all branches of Engineering—Mechanical, Electrical, Civil, Auto., Aero., Radio, etc., Building, etc. If you're earning less than £14 a week, tell us what interests you and write for your copy of "ENGINEERING OPPORTUNITIES" today—FREE!

176 PAGES Free!

B.I.E.T.
387, Shakespeare Hse., 17-19, Stratford Place, London, W.1.
BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY

MUMETAL and RADIOMETAL TRANSFORMERS and CHOKES

As Specialists with many years of experience we can design and supply practically any type of transformer or choke with a nickel iron core for use on a band within the frequency range

1 c/s to 150 kc/s

Available for rapid delivery:—Microphone Transformers, Input Transformers, Line Transformers, Pickup Transformers, Output Transformers, Rectifier Transformers, Vibrator Transformers, High Fidelity Transformers, Recorder Transformers, Midget Transformers, High Q Chokes, High Inductance Chokes, etc., with or without Mumetal Shields.

MAINS COMPONENTS ARE ALSO STOCKED

SOWTER TRANSFORMERS
E. A. SOWTER, 1-8 HEAD STREET, COLCHESTER.
Phone: COLCHESTER 5478

Printed in Great Britain for the Publishers, ILIFFE AND SONS LTD., Dorset House, Stamford Street, London, S.E.1, by THE CORNWALL PRESS LTD., Paris Garden, Stamford Street, London, S.E.1. "Wireless World" can be obtained abroad from the following—AUSTRALIA and NEW ZEALAND: Gordon & Gotch, Ltd. INDIA: A. H. Wheeler & Co. CANADA: Imperial News Co.; Gordon & Gotch, Ltd. SOUTH AFRICA: Central News Agency, Ltd.; William Dawson & Sons (S.A.), Ltd. UNITED STATES: The International News Co.

ETCHED FOIL

DRY ELECTROLYTIC CONDENSERS

CAP. in μF	PEAK W.K.G. VOLTS	DIMENSIONS IN INCHES Lgth.	Diam.	TYPE NUMBER
8	150	1¼	¾	CE71FE
60-100	275	4¼	1¼	CE37HF
8	350	1¼	¾	CE17LE
160	350	4¼	1¼	CE37LE
16-16	350	2¼	1	CE34LE
60-100	350	4¼	1¼	CE37LEA
8	450	1¼	¾	CE18PE
8-8	450	2¼	1	CE34PE
16-16	450	2¼	1	CE35PE
32-32	450	4¼	1¼	CE37PE

THESE Etched Foil types provide very large capacities in an extremely compact form. They are hermetically sealed into aluminium tubes or cans and employ "ALL-ALUMINIUM" construction.

The advancement in technique now enables the production of Etched Foil Electrolytics which are comparable in reliability to the well-tried Plain Foil types, and they can be used in both reservoir and smoothing positions where the ripple ratings are not exceeded.

As a general guide, the ripple ratings of Etched Foil Condensers are roughly half those of equivalent Plain Foil Condensers.

T.C.C. Condensers are exclusively specified in the View Master—the Television Set you build at home from standard parts. Constructor Envelopes (Model A, London, or Model B, Sutton Coldfield) 5/- each from all Wireless Shops.

THE TELEGRAPH CONDENSER CO. LTD

RADIO DIVISION NORTH ACTON, LONDON, W.3. Tel: ACORN 0061

ON BOTH SIDES OF THE ATLANTIC LEADING MANUFACTURERS OF

TELEVISION AND RADIO prefer ERSIN MULTICORE SOLDER

TECHNICAL ADVANTAGES

MULTICORE SOLDER

Three separate cores of flux eliminate possibility of no flux in a portion of the wire. Guaranteed continuity of the flux streams prevent "dry" joints.

Although there are three cores of flux in Multicore, the total percentage of flux to solder is less than most other solders.

Very rapid melting results from the multiple core construction which provides thinner walls of solder than are found in same gauge single cored solder.

Ability to tin rapidly produces perfect joints with less solder. Greater coverage per pound.

ERSIN FLUX

Ersin Flux—exclusive to Multicore—is a high grade rosin, homogeneously activated.

Ersin Flux has a vigorous fluxing action and possesses the non-corrosive and protective feature of the original rosin. Soldered joints made with Ersin Flux do not corrode even after prolonged exposure to any degree of humidity. It has been tested under climatic conditions ranging from the Arctic to the Tropics.

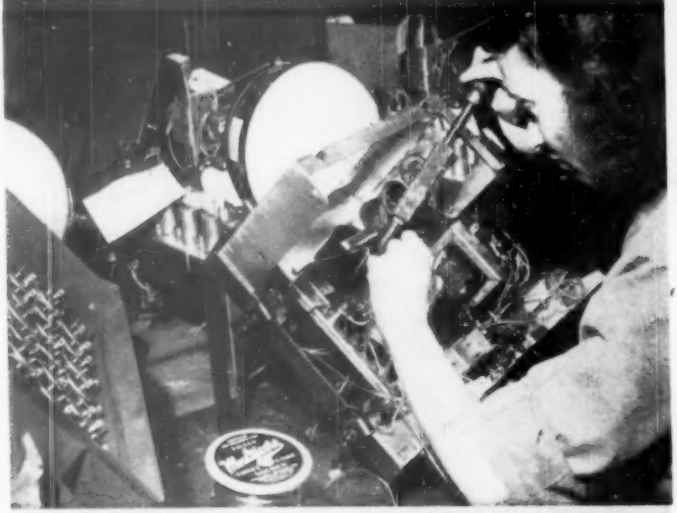
Free from objectionable odour—non toxic in use.

Technical information, samples and bulk prices for manufacturers on request.

SIZE 1 CARTON—5/- RETAIL

Catalogue Ref. No.	Alloy Tin Lead	S.W.G.	Approx. Length per Carton
C16014	60 40	14	26 feet
*C16018	60 40	18	60 feet
C14013	40 60	13	22 feet
C14016	40 60	16	42 feet

* *Specially recommended for Television service and manufacture.*



This operative at Ekco Works, Southend-on-Sea is assembling one of the new Ekco Television sets with Ersin Multicore Solder. Manufacturers in both Britain and U.S.A. prefer to use Ersin Multicore Solder because it alone gives a reliable standard of sound precision soldered joints, at high speed, without waste.

Compare standards of

QUALITY

Ersin Multicore Solder is approved by A.I.D., and G.P.O. It has been used by the leading Government Departments for more than ten years. There is a suitable alloy and gauge for every electronic equipment soldering need.

Compare standards of

PURITY

Only virgin metals of the highest possible degree of purity are used in the manufacture of Ersin Multicore Solder. The non-corrosive Ersin Flux is manufactured under laboratory controlled conditions, before it is incorporated in the three cores of Ersin Multicore Solder.

Compare standards of

MANUFACTURE

Every reel and carton of Ersin Multicore Solder is colour coded and shows the exact tin/lead content and gauge. Supplies are available for manufacturers on 7lb. and 1lb. reels and 1lb. cartons. Size 1 cartons in 4 specifications—shown on left—are a convenient size for service engineers and radio technicians.

MULTICORE SOLDERS LTD.

MELLIER HOUSE, ALBEMARLE STREET, LONDON, W.1 • REGent 1411